Conduit

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

Randomness is Beautiful: in Search of von Neumann

Notes from the Chair: the Latest News from 115 Waterman

Greetings to All CS Alums, Supporters and Friends!

The 2006 academic year is coming to a close, and in true fashion, the computer science department is abuzz with activity. The spring semester has brought some significant changes for us—some resulting in great joy and others with disappointment.

Staffing Changes

After twenty-five years of service to Brown and the department, Trina Avery retired this March. A wonderful send-off was held at the Faculty Club which featured heartfelt memories shared by past chairs and colleagues (see photos and a piece by Peter Wegner on page 31). While we regret Trina's departure, we have warmly welcomed the arrival of Jennifer Crockett as the new executive officer. Jennifer was the former assistant director of the Center for Materials Science and Engineering (CMSE) at MIT and most recently, the director of government cost compliance at the University of Cincinnati. She holds a M.B.A. from Suffolk University. We have high expectations that Jennifer will successfully transition the department to meet the ever-increasing needs of our faculty, staff and students.

We would also like to acknowledge that Jennet Kirschenbaum, who provided secretarial support to the department since its inception, and was, most recently, the executive assistant to the chair, has departed Brown. We will miss her presence and departmental knowledge immensely.

Finally, congratulations are offered to Lauren Relyea who was promoted to faculty and student affairs manager in January. Lauren has done wonderful work with the various aspects of graduate recruiting, and we look forward to her involvement in all of our academic programs.

Faculty Accolades

The first months of the new year brought a number of awards and honors to our faculty and students. Congratulations are in order for the following people: Shriram Krishnamurthi, promoted to associate professor with tenure; Maurice Herlihy, named ACM Fellow; Amy Greenwald, receipt of Sloan Fellowship; Chad Jenkins and Meinolf Sellmann, selected for Brown University's Salomon Award; Gregory Harm '06, Honorable Mention for the Computing Research Association's Outstanding Undergraduate Award; and Andy van Dam, for his work in the creation of the Microsoft Center for Research on Pen-Centric Computing. Additional details about these awards, and others, can be found within this publication.

Enrollment

We are pleased to observe that after several years of declining undergraduate enrollments in computer science nationwide, the trend is now reversing for our department. Recent recruiting events for both newly accepted undergraduate students and those interested in pursuing a computer science concentration have been very successful. Thanks are extended to Tom Doeppner, Teresa McRann '06, and the staff and student volunteers whose assistance made these events so successful. We are also pleased to note that we continue to make progress in expanding the Sc.M. program and hope to heighten the visibility of both full-time and part-time study options in the near future.

Alumni Outreach

Be sure to mark Saturday, May 27th, 2006 as the date of the next Computer Science Reunion and Networking Reception. We encourage all alums, friends and supporters to make plans to attend. As those who attended last year's event can attest, it's certain to be a fantastic time! Please register for the reunion at: www.cs.brown.edu/events/reunion/home.html.

Finally, I'd like to offer a "job well done!" to *Conduit* Editor-in-Chief Laura Zurowski for her efforts in re-designing this publication over the past year. Our goal for *Conduit* is to provide a forum for those Brown alums interested in the technology research that our faculty, students and alums are engaged in—and we hope that you enjoy each issue. We urge you to submit your comments, contribute your research and personal stories, and become involved with the growth and evolution of this publication. Your support and participation are always appreciated.

Keep in touch!

Eli Upfal
Chair, Computer Science Department

Volume 15, Number 1

Spring | Summer 2006

Conduit

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

Queries about this publication can be directed to: conduit@cs.brown.edu

Our campus mailing address is:
115 Waterman Street
Campus Box 1910
Providence, RI 02912

PUBLISHER
Industrial Partners Program,
Department of Computer Science

EDITOR-IN-CHIEF
Laura Zurowski

FACULTY EDITOR
Eugene Charniak

COPY EDITOR
Amy Leavitt

GRAPHIC DESIGN
John deWolf, Public Information Design

CONDUIT ON THE WEB
John Bazik
Kathy Kirman

PRINTING AND DISTRIBUTION
Brett Turner and the wonderful folks at Graphic Services!

BROWN

Cover photo: Andy Deans
Cover design: John deWolf

FEATURE

RESEARCH

FACULTY

3.4.5.

ALUMNI

Learning Autonomous Robot Control from Demonstration

Assistant Professor **Chad Jenkins'** research leverages the idea that robot control and computational perception are better learned from human demonstration rather than explicit computer programming.

In recent years, technological advancements have resulted in more capable robot hardware with increasingly broad applicability through society, such as Sony's AIBO and iRobot's Roomba. Despite the great strides in sensing, actuation, and computation, developing autonomous control policies (programs to control the robot) has remained a difficult problem in robotics. A robot is defined as a machine (embodied in some physical form) that uses a control policy to act (or actuate its motors) based on information about its environment (provided by its sensors). Even when restricted to highly constrained domains, the manual crafting of a robot control policy can be a tedious and time-consuming endeavor requiring a considerable amount of technical skill. Furthermore, such controllers often lack scalability for modifying the robot's behavior as new or unforeseen functionality becomes desired.

ABOVE Brown's two RoboCup teams will use the Sony Aibo. Teams of four dogs will compete against each other in a soccer match.
BELOW Robo-Dog makes a save! (and the fans go wild...)

A viable approach to development of autonomous robot controllers is learning them from human demonstration. Human beings are apt at devising control policies that yield functional behavior in a dynamic environment, which is especially true for video games. Unfortunately, most humans are unable to transfer their expertise onto the robot. The barrier exists because explicitly programming a computer language is often required for robot programming and most people are not computer programmers. Our aim is to implicitly transfer human expertise into robot control policies through human-robot collaboration or instruction.

Our research in this area aims to extend methods for learning from demonstration towards applicability for general sets of tasks and multi-robot domains. That is, given a set of sensory inputs and corresponding motor outputs, learning their functional relationship. By observing a human demonstrator, our systems attempt to learn the function exhibited by the human that produces motor commands from the data provided by the robot's sensors. Once learned, the robot uses this sensory-motor function to autonomously assess situational context, assign tasks to robots, and perform the learned tasks at run-time. In addition, we seek to develop methods that allow a robot to generalize and refine a learned policy for new situations and better performance in familiar scenarios.

RoboCup

One interesting application of this work is in the domain of robot soccer, specifically, RoboCup. RoboCup is a worldwide research and education initiative focused on advancing the state-of-the-art through annual robotic soccer competitions. Unlike typical competitions (e.g., FIRST, BattleBots), the robots operate in full autonomy without external control or resources. The high-level goal of RoboCup is to foster artificial intelligence and robotics research with respect to a standard problem. The dream of this initiative is to develop a team of humanoid robots capable of winning against the official human WorldCup Champion before 2050. During the fall of 2005, the Brown RoboCup team was established to field competitive robot soccer teams and explore methods for learning soccer skills and strategies from demonstrations. While several RoboCup leagues exist for different aspects of the greater challenge, we focus on the Sony Four-Legged Robot League, where Sony Aibo robots play in teams of four.

With the support of a Brown Salomon grant, Brown RoboCup is sending two teams, Brown # (read: Pound) and DemonstraDogs, to compete in the RoboCup US Open, our first competition, in Atlanta this April. The Brown # uses manually programmed control routines created by our development team of Sc.M. students including captain, Ethan Leland, and programmers Brendan Dickinson and Mark Moseley. DemonstraDogs leverages the research of doctoral student Dan Grollman to learn soccer control policies from human teleoperation of robot teams.

"RoboCup is a worldwide research and education initiative focused on advancing the state-of-the-art through annual robotic soccer competitions."

Research Directions

Though learning from demonstration is a promising avenue for advancing robotics, there are several general questions that remain. Among these questions, the issue of generalization figures to be the most prominent. Generalization deals with the ability to extrapolate beyond the scenarios explicitly demonstrated by a human. Machine learning offers many methods for addressing the generalization problem through regression and reinforcement learning. We are currently exploring which methods in this space, if any, are suited to generalization in limited and broader domains.

In parallel, we are undertaking an effort to collect large datasets of sensory-motor data from human control to minimize the magnitude of the generalization problem. Given human capabilities and interest in video games, we believe there is an opportunity to learn superior soccer policies while broadening interest in computer science.

Over the long term, we expect a convergence between learning from demonstration with time-critical decision making, as in our collaborations with Brown Assistant Professor Meinolf Sellmann. In this regard, learning is used to perform symbol grounding, that is, the discretization of a continuous control policy into a set of symbols. Once symbolized, we will explore the use of combinatorial optimization for decision making about the group behavior of a soccer team. If optimization can be performed in a time-critical fashion, it has the potential to find optimal play selections and task allocations (i.e., assignments of robots to roles) for competitive soccer. **C!**

C! Comments?

Send your views to: Conduit,
Department of Computer Science,
Brown University, Box 1910,
Providence, RI 02912
or email conduit@cs.brown.edu

Ph.D. Profiles

Aris Anagnostopoulos

Aris did his undergraduate studies in the computer engineering and informatics department at the University of Patras, Greece. He joined Brown University in 2000 and started working with his advisor, Professor Eli Upfal, in the area of algorithms, and in particular on stochastic analysis of protocols for networks. During the summers of 2004 and 2005 he interned at the IBM T.J. Watson Research Center, under the supervision of Andrei Broder, on problems related to web searching. Their paper "Sampling Search-Engine Results,"(with David Carmel at the IBM Haifa Research Lab) was accepted in the WWW 2005 conference and was runner up for best paper. Aris' other research interests include information security, stream processing and combinatorial optimization.

Ionut Aron

Ionut started his Ph.D. at Brown in 2001, working in the area of combinatorial optimization under the direction of Professor Pascal Van Hentenryck. His Ph.D. work has focused on the integration of constraint programming, developed and used mainly by the artificial intelligence community, with mathematical programming, used primarily in operations research. Due to the interdisciplinary nature of this work, Ionut spent three semesters at Carnegie Mellon University. While at CMU, he worked with researchers from the operations research group at the Tepper School of Business. Ionut returned to Brown in January, 2004, and is now completing his dissertation work. At the end of the 2006 spring semester, he will join the optimization group in the mathematical sciences department at the IBM T.J. Watson Research Center.

Nesime Tatbul

Nesime received her B.S. and M.S. degrees in computer engineering from the Middle East Technical University in Turkey. In 1999, she started her Ph.D. studies at Brown, working with Professor Stan Zdonik in the area of database systems. Her thesis research focuses on load management techniques for large-scale data stream processing systems. In particular, she has designed and implemented load shedding techniques for the Aurora/Borealis prototype systems, which support continuous real-time processing and monitoring over high-speed data streams. Nesime spent the summer of 2002 at the IBM Almaden Research Center, where she worked on replication-based update handling mechanisms for database caching. From 2003–2005, she worked as a consultant for the U.S. Army Research Institute of Environmental Medicine on developing data management solutions for wireless sensor networks. Nesime expects to complete her Ph.D. by summer 2006. **C!**

Computer Games and Formal Learning Programs

Clark Bennett Aldrich '89 was the lead designer of SimuLearn's *Virtual Leader* (Best Online Product of the Year, *T+D* magazine, 2004), and the author of the books *Simulations and the Future of Learning* (Wiley, 2004) and *Learning by Doing: The Essential Guide to Simulations, Computer Games, and Pedagogy in E-Learning and other Educational Experiences* (Wiley, 2005). He can be contacted at clark.aldrich@simulearn.net.

TOP AND MIDDLE Screen images from *Virtual Leader.*

BOTTOM Academic, military and corporate enterprises have used *Virtual Leader* for management training.

Computer games often come in *genres*, which are established packages of interface, situations, systems, and goals. These genres, including first-person shooters, real-time strategy, and sports are optimized for entertainment.

But can the same underlining philosophies be used to create entirely new genres of interactive experiences, optimized for formal learning? And can such educational simulations both better capture and better nurture specific domain expertise? Finally, can some categories of critical content, traditionally eschewed by most educational institutions due to the limitation of lecture/paper, finally be scalably, predictably, and measurably deployed using these new techniques?

Creating Virtual Leader

I was an analyst at Gartner, focused on formal learning programs in enterprises. I would get dozens of requests for help in developing people in "big" skills including leadership, project management, innovation, stewardship, and relationship management. Organizations from corporate to academic, military, and even non-profit were frustrated at being hunter-gatherers with these most critical areas.

After quite a bit of research, I agreed not only that using lecture/paper was not going to contribute significantly to developing these skills, but also that there were no current viable, scalable alternatives. Meanwhile, I also considered myself a mid-weight "gamer," and recognized the powerful but incomplete concepts computer games brought to bear. So I left Gartner and formed a team of game designers, artists, AI-designers, educational designers, and entrepreneurs to take the skill of *leadership*, and build an educational simulation around it.

In the same spirit that Will Wright used a dollhouse as an entry-metaphor into his *The Sims* series, and a model railroad for *SimCity*, we choose a *meeting* as both a metaphor and a "where the rubber hits the road" for our leadership content. We built a comprehensive systems-based model around leadership, the first time, to my knowledge, anyone had to do that. The interface itself, meanwhile, had to give users the ability to interact with the avatars in real-time at a strategic level, ultimately presenting over twenty options at any given time that were all just a click away. While the simulation in no way requires "twitch" reflexes, there is a constant kinesthetic component. Having said that, one of the hardest choices is knowing when to do nothing, and let events play out on their own.

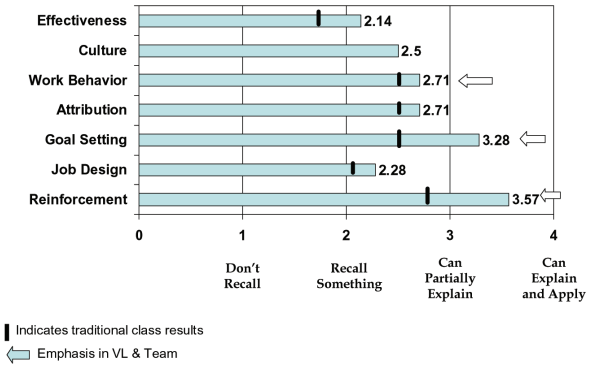
We called our simulation *Virtual Leader*. The early scenarios challenged students to use but not overuse the formal authority they had been granted, mimicking the challenges of many new leaders. By the end of the simulated experience, students kept themselves from becoming too manipulative and using people and ideas without heed of the human consequences.

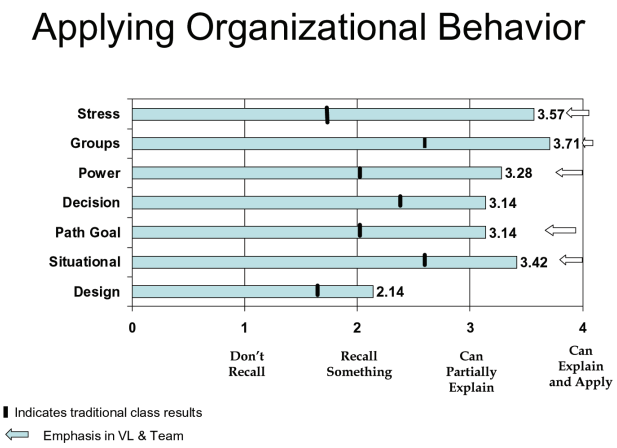
We also made the experience more "fun" than realistic in a few ways, creating an overarching story where the players gain power within the organization more quickly than they might in real-life and a high-score capability where people could compare their scores against a predefined population. We also added many pedagogical elements to the experience, including dynamic charts, after-action reviews, and support material.

Virtual Leader has been deployed in many organizations including academic, military, and corporate, and we continue to study the results rigorously. In academic deployments, when used as a lab, *Virtual Leader* significantly increases the retention and application of the content. The graph on the following page represents one study from Troy University by John Dunning, used in his "Organizational Behavior" class that quantifies the magnitude of that impact.

Meanwhile, in the military and corporations, we have seen increases in absolute productivity when team leaders have gone through the *Virtual Leader* simulation in the range of 21 to 24%. For a five-day workweek, this is like getting an extra day of work every week. More importantly, this extra productivity does not come at the expense of the team, but through the support of the team. In a psychiatrist-administered review, administered five months after completing *Virtual Leader*, the targets/students were rated to have significantly less "negative behavior" and more "positive behavior" by their peers, subordinates, superiors, and selves.

I like to look at a final "metric" as well. When engaging *Virtual Leader*, the students are absolutely focused and engaged, in contrast to





ABOVE John Dunning of Troy University compared the learning and behavioral outcomes of students who used *Virtual Leader* as part of their "Organizational Behavior" curriculum to those who did not.

most classrooms where they are leaning back and disengaged. More importantly, the students who have used *Virtual Leader*, when talking about both their experiences in the program and leadership experiences outside of the program, talk with a confident and nuance, even a situational awareness, that belies their actual age and experience. They sound like seasoned veterans.

Some typical comments include

"I noticed while working with people that I began to think and respond as if I were in the simulation."

"I was pleasantly surprised at its realistic representation of how ideas, tension, objectives and personal influence all contribute to the success, or failure, of a situation. I've started to see the *Virtual Leader* concepts appear in "real world" moments. (I have to admit that I even found myself involving a silent colleague by writing "Ed, I bet you have something on your mind." I laughed to myself at how second nature the phrases of the simulations had become to me!)"

"Our meetings follow an agenda and little discussion is made about any topic. The meetings rarely produce any results. Meetings wane between being too relaxed or extremely tense and no work is accomplished. In the recent meeting, a recruiter was reporting about the high level of job vacancies in the organization. The supervisor wanted to know why there was such a high vacancy rate, but did so in a very accusatory way. The recruiter became very tense, as did others in the room. I was internally clicking on the red zone of the manager, but instead decided to literally click on the green zone of the recruiter. I complimented her on her ability to fill positions with qualified candidates in the past. I asked her what her approaches had been that made her successful. The recruiter relaxed a little, and she discussed what she had done in the past. As the entire group talked about the issue, the tension leveled off into the productive range, and we began to discuss recruitment strategies. This is something that has never been discussed in a department meeting, and by the end, the group had come up with some great ideas. I showed the supervisor that I do have the capability she thought I was lacking to be successful in the department."

The SimuLearn team is working with other universities to independently study just how wide-ranging the impact of *Virtual Leader* is. With our Japanese, Korean, and now Chinese versions becoming available, we will have a chance to study the impact across cultures. But from the first two years of deployment, there is tremendous excitement that this approach might change the very nature of educational experiences, including what content can be taught, how it can be taught, and the impact of these experiences. **C!**

"We called our simulation *Virtual Leader*. The early scenarios challenged students to use but not overuse the formal authority they had been granted, mimicking the challenges of many new leaders."

Simulation Philosophies

Simulation Philosophies is a new column featuring **Clark Bennett Aldrich**'s musings on computer games, learning and technology. His "SIM Word of the Day" series can be found at learningcircuits.blogspot.com.

One of the most immutable laws of education is "what is taught is governed by what can be taught." Curricula have been shaped for generations by this other "invisible hand," the content constraints of lecture/paper, often without our realization. But every subsequent class, starting with the so-called "Generation X," is viewing content through an increasingly non-linear and active lens, shaped in part by experiences with ever more complex computer games.

In my own role as analyst and simulation designer, I have been collecting terms that embody this new philosophy. Here are a few:

Actuators/Units: Computer games are filled with actuators. Actuators turn one resource into another. They might turn money into customer satisfaction. They might turn research into finished products. They can be bought, built, placed, and upgraded. They might require a constant stream of resources (fixed costs) and/or variable. They can be destroyed, or shut down. They might have some advantage if geographically positioned close to map-based resources or close to other actuators.

There is a special case of actuators called units. Units typically can move. They have some form of Artificial Intelligence (AI). They can scout around. They can perform different types of work, often depending on their specialty. They can be given priorities. They can swarm. They move at different speeds, and have different capabilities. They can also be distracted, and do things that were once useful but no longer. They can differ from each other as well, in capability and even in ideal working conditions.

What is amazing is that when talking to CEO's of large and very large organizations, they use much the same language. They think about capabilities. They think about optimizing. They think about value chains. They try to take money and time out of processes. They are always interested in replacing unpredictability with predictability. They are interested in opening up new avenues.

And as I like to say, when computer gamers and CEO's agree on reification frameworks, can schools be far behind?

Playing out Information: One of the most interesting things about good computer games is the way that information is played out. In *Half Life 2*, there are creatures that are mounted to ceilings with long tongues that hang down and grab things for food.

One technique to inform the player might have been an encyclopedia-like screen giving some information about these creatures. Another would be to have a virtual colleague say something like, "Careful—those tongue creatures are hungry and once they grab you, it's over."

Instead, *Half-Life 2* carefully builds the awareness in the player, and then pushes it. They first show the player what these creatures do by, in this case, having an unwary crow get scooped up. Then they expose the player to simple situations with a single creature. A few levels later, the player has to get through dozens of these creatures using increasingly clever techniques, including improvised hybrid strategies learned from other parts of the game.

The instructional design fascists say, "Tell them what you are going to tell them, tell them, tell them what you told them." What they are really teaching their audiences is how to be idiots. Thank goodness computer games have more respect for our intelligence.

Hero: Hero is a very tricky word in the education industry. In decades of formal learning experiences, I have seldom, if ever, played the role of a hero. In classic mythology, heroes live apart from the rest of society, having special responsibilities and getting special perks. In most computer games, you play the unique hero—the person who has the power to save the day, or at least make all of the decisions. In massive, multiplayer online role-playing games, we see the emergence of a band of heroes, groups of equals coming together to go on some quest.

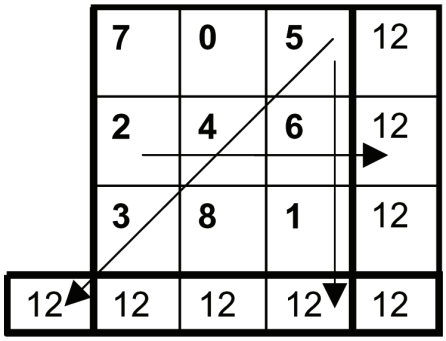
The role of "a hero" is challenging in educational simulations. Most of us want to be heroes, although some want it more than others. Should schools encourage people to be heroes? Heroes often break rules, something that every centralized department hates. Yet, every good organization rewards heroes with praise, even if it is along the narrow definition of performing a traditional activity with unusual vigor.

Finally, logistically, programming the user to be a hero in an educational simulation feels funny. Do you give your player the most power to make a difference? If yes, the sim feels false. If no, the sim is unsatisfying. **C!**

Faster Seeking with Dumbledore

Assistant Professor **Meinolf Sellmann**'s research focuses on hard combinatorial feasibility and optimization problems as they arise in the context of real-world applications such as airline crew scheduling, automatic recording, and capacitated network design.

Recently, my colleague Professor Carla Gomes from Cornell University and I worked on a computer program that can construct mathematical objects that are known as "magic squares". Magic squares are n-x-n squares that contain the numbers 0,..,n^2-1 such that every row sum, column sum, and diagonal sum are equal. Despite the fact that humans know ways to construct these matrices with ease, computers have severe difficulties to construct magic-squares if the construction is not hard-coded into the computer program.



Example for n=3 (note how each row, column, and main diagonal sums up to 12):

Interestingly we found that, if we ask a computer to search for a very special kind of magic squares, then the construction becomes significantly easier for the machine, which is at first very surprising. To give an analogue example: Say that we are looking for diamonds, and without a map, it is very hard to find any. Then someone asks us to find bright yellow diamonds only, and suddenly our search becomes much easier. The reason why this might be the case is that the places where we see any chance to find bright yellow diamonds are much fewer than the places where we could look for just any diamonds. Consequently, our search becomes much more targeted, and we succeed faster. With respect to magic squares (the diamonds that we look for), we asked the computer to look only for those that have a very special structure (that corresponds to the property "bright yellow" in our analogy). If we divide each matrix value by the dimension n of the square and round the result down, then we get a new square that contains values 0,..,n-1 only.

For our example above, we can now see another square that was hidden in the original one:

7	0	5
2	4	6
3	8	1

→

2	0	1
0	1	2
1	2	0

Note how for this example the hidden square is very special: every row and column now has all values 0,..,n-1. These squares are generally referred to as "Latin squares". So in summary, having a computer look for a magic square causes great computational problems. When asking a computer to only look for magic squares that hide a Latin square in them, then the computer can construct much larger squares.

In honor of the great idea to hide the Philosopher's Stone in the Mirror of Erised, we named magic squares that hide Latin squares "Dumbledore squares". We refer to the technique to add structural constraints to target the search for solutions to under-constrained problems as "streamlining". It marks a radical departure from traditional techniques that only limit the search to structures that must hold for all feasible solutions rather than just a subset of them. In order to be effective, we believe that streamlining constraints needs to focus the search to a much smaller search space and preferably increase the solution density. On more practically relevant problems, the idea to streamline the search to find structured solutions has lead to massive improvements in the computation for spatially balanced Latin squares that play an important role in the design of agricultural field experiments. **C!**

ABOVE Meinolf demonstrates his ability for working magic with image editing software with this pictorial representation of "Meinolf Sellman and the Dumbledore Squares."

Sorin Istrail is professor of computer science and will hold the first chaired professorship at Brown's Center for Computational Molecular Biology.
Tracie Sweeney is a senior associate director in the Office of Public Affairs and University Relations.

The career path for many people follows a well-mapped route. My professional journey, however, has taken me from government work, to industry, and to academia; from computer science, to biology, to physics, and to computational biology. In my computational biology journey, each step, every partnership, has taken place in an "intellectual Camelot"—communities of intellectual culture working on exceedingly hard problems. Places like Sandia Labs, where people worked in the shadows of the brilliant minds of the Manhattan Project to advance the nation's science, engineering, and defense projects. Like Celera Genomics, where an interdisciplinary team of scientists made landmark advances in genomics.

> "There exists today a very elaborate system of formal logic, and specifically, of logic as applied to mathematics. This is a discipline with many good sides, but also with certain serious weaknesses. ...Everybody who has worked in formal logic will confirm that it is one of the technically most refractory parts of mathematics. The reason for this is that it deals with rigid, all-or-none concepts, and has very little contact with the continuous concept of the real or of complex number, that is, with mathematical analysis. Yet analysis is the technically most successful and best-elaborated part of mathematics. Thus formal logic is, by the nature of its approach, cut off from the best cultivated portions of mathematics, and forced onto the most difficult part of mathematical terrain, into combinatorics." - John von Neumann

Combinatorics, as the most refractory part of mathematics, is one of the connecting threads of my story. And indeed, I was trained to appreciate both analysis and mathematical logic. World-class mathematicians Solomon Marcus and Sergiu Rudeanu, my advisers when I was a computer science doctoral student in Romania, were, respectively, specialists in mathematical analysis and mathematical logic.

ABOVE John von Neumann is widely regarded as the greatest scientist of the 20th century after Einstein.

I was fond of Johnny von Neumann since graduate school, and my American journey, especially in New Mexico, the Land of Enchantment, brought me closer to him. Let me introduce Johnny with the words of Norman Macrae, his biographer:

> "John von Neumann is widely regarded as the greatest scientist of the 20th century after Einstein. Born in Budapest in 1903, John von Neumann grew up in one of the most extraordinary of scientific communities. From his arrival in America in the mid 1930s—with bases in Boston, Princeton, Washington, and Los Alamos—von Neumann pioneered and participated in the major scientific and political dramas of the next three decades, leaving his mark on more fields of scientific endeavor than any other scientist. Von Neumann's work in areas such as game theory, mathematics, physics, and meteorology formed the building blocks for the most important discoveries of the century: the modern computer, game theory, the atomic bomb, radar, and artificial intelligence, to name a few. From the laboratory to the highest levels of government, he was an essential driver of these world-changing discoveries."

SANDIA

In 1992, on my first day at Sandia National Laboratories in Albuquerque, my manager Ernie Brickell handed me a pile of books and said, "You are the Computational Biology Project at Sandia. Apply for grants from the DOE." The next day, I flew to New Jersey for a three-week computational biology tutorial workshop at Rutgers University. There, I met Michael Waterman. He visited me regularly at Sandia (and later at Celera), and over the years became a dear friend and collaborator. Through computational biology by way of New Mexico, it was Michael who brought me closest to von Neumann. When I returned from the workshop, I prepared a grant application aimed at the DOE's Applied Mathematics Program (MICS), which was the continuation of the Applied Mathematics Program started at DOE by von Neumann while he was a member of the Atomic Energy Commission. Fred Howes, the MICS program manager, was in love with computational biology. With his passionate support over the years, I established and led the Computational Biology Project, the only biology program at Sandia at that time.

The Protein Folding Problem

Synergy and serendipity, which often have a hand in scientific advances, played a part in my entry to the world of protein folding in 1994. I had been invited to talk about genomic mapping at a Telluride workshop titled "Open Problems in Computational Biology." On the eve of my presentation, I was listening to Ron Unger's talk on protein folding when he revealed to the audience that nature can solve NP-complete problems, because in some obscure model, the protein folding problem was proved NP-complete. The following day, I shot down his argument using a series of cartoons, based on the cartoons from the Garey and Johnson book, that I had developed overnight.

The ensuing passionate discussions that Ron and I shared during long walks in beautiful Telluride exposed me for the first time to this most-famous open problem. My cartoons advocated using approximation algorithms. Because of them,

Ron challenged me to find approximation algorithms for Ken Dill's HP model, a simplified protein lattice model studied for decades by hundred of researchers. If you are so critical of my way, Ron challenged, you give it a go, and see how hard it is.

I returned to Sandia and, with Bill Hart, a newly arrived postdoctoral fellow, we solved the problem in a few months. Our approximation algorithm with mathematically guaranteed error bounds would fold every HP lattice protein to a folded conformation with energy of better than 3/8 of optimal energy (number of contacts). Our paper was published in STOC 95 and then in the Journal of Computational Biology. Although the result was theoretical for a lattice protein model, Science magazine announced shortly after the news that Sandia's computer scientists had hit pay dirt with research on protein folding – and the deep computer science concept of "approximation algorithm with guaranteed error bounds" began to make the rounds among researchers involved in protein folding. It opened a new area of study, and dozens of follow-up papers, with similar results in many crystal lattices, have been published since.

> "The most vitally characteristic fact about mathematics is, in my opinion, its quite peculiar relationship to the natural sciences. ...In modern empirical sciences it has become more and more a major criterion of success whether they have become accessible to the mathematical method or to the near-mathematical methods of physics. Indeed, throughout the natural sciences an unbroken chain of successive pseudomorphoses, all of them pressing toward mathematics, and almost identified with the idea of scientific progress, has become more and more evident. Biology becomes increasingly pervaded by chemistry and physics, chemistry by experimental and theoretical physics, and physics by very mathematical forms of theoretical physics. This double face is the face of mathematics, and I do not believe that any simplified, unitarian view of the thing is possible without sacrificing the essence."
> - John von Neumann

This double face of mathematics is at the heart of the flaw in Ron's argument. NP-completeness is about mathematical models. Considering both the model and the "modelee" (the protein folding process) of the same type violates von Neumann "double face of mathematics" axiom. Even then, the argument does not work because the model is not only a simplification, but a generalization as well, of the modelee.

The 3D Ising Model Problem

From my first week at Sandia, a colleague down the hall, Bill Camp, started talking to me about the Ising model. I had no background in statistical mechanics and thermodynamics, so his conversations often were hard to follow. One thing was clear: His enthusiasm was infectious.

He shared with me some of the problem's fascinating history, and in doing so, passed the torch to me from his former Ph.D. advisor, Michael Fisher, a member of an extraordinary team that between 1925 and 1972 worked on the 3D Ising Model Problem.

ABOVE At his son Larry's Bar-Mitzvah in the Ulam Ballroom at the Doubletree Hotel in Albuquerque. Sorin (left) with Larry and John Conway, the John von Neumann Professor at Princeton.

In 1944, future Nobelist Lars Onsager provided the first exactly solved model that exhibits a mathematically provable phase transition. The model was the Ising model of ferromagnetism on the two-dimensional square lattice. It became statistical mechanics' Holy Grail for a 2D model.

Onsager's solution energized some of the most brilliant physicists and mathematicians in the quest for the generalization of the method for three dimensions. Decades of research conducted by the likes of such Nobelists as Onsager, Feynman, Fermi, and mathematicians such as Mark Kac and Michael Fisher uncovered new methods, but no exactly solvable three-dimensional model. In 1985, Kac described the period:

> "The three dimensional case does exhibit a phase transition but exact calculation of its properties has proved hopelessly difficult. The two-dimensional case...was solved by Lars Onsger in 1944. Onsager's solution, a veritable "tour de force" of mathematical ingenuity and inventiveness, uncovered a number of surprising features and started a series of investigations, which continue to this day. The solution was difficult...and George Uhlenbeck urged me to simplify it. 'Make it human' was the way he put it...
> Even Feynman got into the act. He attended two lectures I gave in 1952 at Caltech and came with the clearest and sharpest formulation of what was needed to fill the gap. The only time I have ever seen Feynman take notes was during the two lectures. Usually, he is miles ahead of the speaker but following combinatorial arguments is difficult for all mortals."

Funding pressures pushed me to start working on this area, so I started reading a textbook on statistical mechanics. In less than two years, I realized that the random walk of my career had prepared me to understand this extraordinarily beautiful computational problem and its complexity. In my STOC 2000, I published a theorem: "The world of the Ising Model is flat!": For each and every 3D Ising model (in its standard studied versions), computing the partition function was NP-complete. The impact of this Flatland theorem earned it a listing (No. 7) in the Advanced Scientific Computing category of the top 100 most distinguished achievements in the DOE's first 25 years.

Although I provided a "negative solution" to the problem in only a number of model settings, the "Flatland" nature of my result, matching the large volume of failed attempts, received a lot of attention. "NP-completeness," the most trea-

sured paradigm in computer science, is a deep concept. In both the protein folding and the 3D Ising models, such rigorous "impossibility" results provide rational vindication of failed efforts. And deep down, they identify combinatorial substructures of the models responsible for intractability.

> "The exactness of mathematics is well illustrated by proofs of impossibility. When asserting that doubling the cube...is impossible, the statement does not merely refer to a temporary limitation of human ability to perform this feat. It goes far beyond this, for it proclaims that never, no matter what, will anybody ever be able to [double the cube]. No other science, or for that matter no other discipline of human endeavor, can even contemplate anything of such finality." - Mark Kac and Stan Ulam, 1968

The Kac-Ulam impossibility proof, although supreme, has "mutated" weaker versions of impossibility, such as NP-completeness. As von Neumann warned us:

> "...the very concept of 'absolute' mathematical rigor is not immutable. The variability of the concept of rigor shows that something else besides mathematical abstraction must enter into the makeup of mathematics... Something nonmathematical, somehow connected with the empirical sciences or with philosophy or both, does enter essentially..."

Science writers' talents flourish in environments with a high density of technical advances. I benefited over the years from the attention of some of the most talented—Barry Cipra (*Science*), Neal Singer (Sandia), and Phil Ball (*Nature*). They find beautiful metaphors to convey complexity: "adulterous proteins," "to fold or not to fold," "Why in Superbowl of statistical mechanics, famous players could never cross the goal line," "Ising on the cake," "Statistical physicists phase out a dream." Of these, the most innovative of all was the *SIAM News* article by Barry Cipra, an award-winning author on the Ising model. Describing my NP-completeness proof of the 3D Ising model, he used Dante's *Inferno* verses/poems for each of the main steps in my proof .[8]

In the late 1990s, several events—coincidental and otherwise—again changed the course of my career.

In 1997, Michael Waterman, Pavel Pevzner and I started in Santa Fe, New Mexico, an annual international conference, RECOMB (Research in Computational Molecular Biology), which has become, arguably, the top conference in computational biology. It just celebrated its 10th birthday this month with a meeting in Venice. Michael, who worked with Stan Ulam at Los Alamos, introduced me to a number of other personalities from that era: François Ulam, Gian-Carlo Rota, Nick Metropolis, Bill Beyer. In Michael, the RECOMB community heard the inspiring echoes of Ulam and von Neumann, two mathematicians in love with biology.

Fred Howes' untimely death in 1999 was the day the music died. (RECOMB honors his legacy with a Distinguished Service Award. Dick Karp delivered the 2004 Fred Howes Award Lecture.) Weeks after Fred's death, Gene Myers enticed me to come to Celera to meet Craig Venter.

And the spirit of von Neumann cast itself over me once again: On the happy occasion of my son Larry's Bar-Mitzvah (held in the Ulam Ballroom at the Doubletree Hotel in Albuquerque), we were honored to have John H. Conway, the John von Neumann Professor at Princeton University, as a guest at the celebration.

ABOVE RECOMB 1997 Conference Banquet: Eric Lander, Michael Waterman, David Botstein, Sorin Istrail, Bill Beyer, and Nick Metropolis

CELERA

My time at Sandia was followed by five years at another "intellectual Camelot"—Celera Genomics, where my role as senior director of the Informatics Research (IR) team was to lead the computational biology effort in the post-genome assembly phase. By creating powerful software libraries of tools for assembly comparison, annotation, mass spectrometry, SNPs and haplotypes, arrays, protein folding, and literature data mining, the IR team became, arguably, the leading computational biology group in the industry.

My interview at Celera was memorable. In my meeting with Craig Venter, I asked about the role of algorithms at Celera. He responded without hesitation: "Algorithms are the make or break of Celera." As "Speed Matters" was the company motto, I joined Celera two weeks later. One by one, all my close collaborators from Sandia as well as former students soon joined my group. "Where do you find all these geeks?" one assistant asked. "Is there a secret club?"

Each and every one of these extraordinarily talented colleagues, geeks or not, became stars of the Celera team. Some of the most opinionated, workaholic overachievers sat around the table to brainstorm, wearing smiles as if to ask "You are going to tell me what to do?"

As I worked closely with Craig, I admired his extraordinary ability to make the impossible possible through his inspiring leadership. Exciting and inspiring leadership, as well as the magnitude of the problem ahead, molded us in such a way that each person, prima donna or not, came to rely upon the others in order to achieve lasting contributions.

"Our CPAs are hopefully behind the times when they estimate a company's net worth in terms of material assets. All businesses today depend ... on the creative thinking of a few eccentric individuals. ...Talent seldom grows in isolation. More often, it benefits from the encouragement and challenge of similar talent. Talent is created by teamwork as much as good teamwork is made up of talent. The most successful teams at the National Labs ...are made up of scientists and engineers who think and work in very similar patterns, and who have learned to spot and appreciate each other's complementary skills. ...Scientific teams are fragile. It takes years, as well as a dose of good luck, to assemble a successful scientific team, and it takes one stroke of the pen to destroy it. Once a research group is broken up, it is all but impossible to put it together again, and a national asset is forever lost." - Nick Metropolis, 1993

The members of the IR team were exceptional, some of the most talented computer scientists and software engineers I had the pleasure to work with. Each taught me a lot and could well join the ranks of my beloved teachers. At Celera, we could not wait to come to work—although everyone worked basically 24 hours a day. We designed some of the most powerful algorithms; we performed some of the largest supercomputing computations. Due to private industry's large investment, we had the fortune to see and analyze for the first time whole genomes and various other immense data sets generated by biotechnology. Buses of high school students would visit the site, and press releases were distributed almost every day. Companies around the globe wanted to work with Celera. Craig was invited to the White House. It was an extraordinary time of our lives. The world was alive. And one day in 2002, the largest DNA sequencing factory on earth was called to national duty to help with DNA identification of the remains of the 9/11 victims. Celera called it the Soaring Eagle project. A tremendous company-wide effort was made because, at that time, speed truly mattered.

Not long after Craig returned from his meeting with President Clinton at the White House, a day came when at Celera the music died: On that dark Monday, we learned that Craig left the company.

Comparison of Genome Assemblies

To understand the state of genomics before Celera, a good reference can be found in a book by Freeman Dyson:

"The human genome project began in 1990 and is supposed to be finished in 2005. In 1999 more than half the time has passed but less than a tenth of the genome has been sequenced. ...In my opinion, the decision of the administrators of the genome project, to finish the sequencing of the entire human genome by year 2005 using existing methods, was unwise. The decision was driven by politics and not by the needs of science and medicine. ...In science, to change the objectives of a program in the light of new discoveries is a sign of wisdom. In politics, it is a sign of weakness. Unfortunately, politics prevailed over science. ...The human genome project at the current cost is not sustainable. ...The cost of sequencing must be reduced, and the speed increased, by a factor of a hundred or a thousand."
- *The Sun, the Genome, and the Internet* (Oxford University Press 1999)

Craig Venter's departure was soon followed by Gene Myers'. For his farewell party, we formed the IR Band that played *IR Genomes*, based upon John Lennon's *Grow Old with Me*:

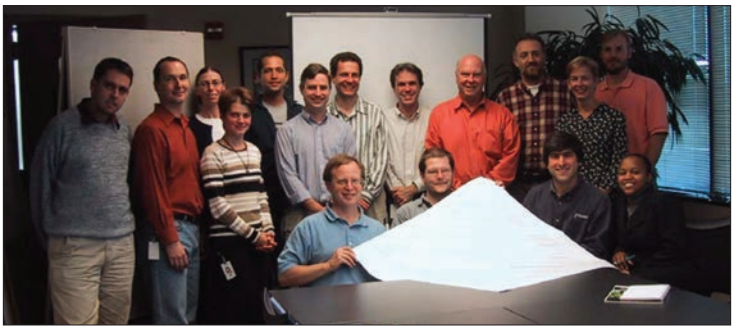
For genomes like you and me
The best is yet to be
When the time has come
We will be as one

We did great things together
Genomics is forever!

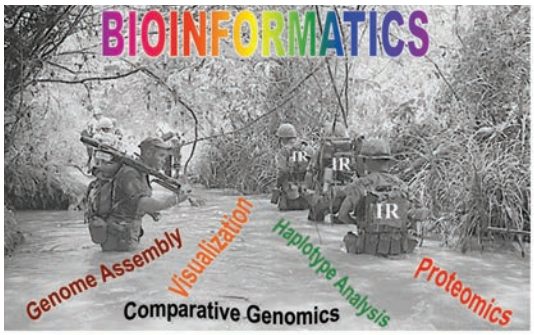
The president of Applied Biosystems, Michael Hunkapiller, and his staff understood immediately that the IR group was the "bioinformatics special forces," and we began to work closer with Applied Biosystems. One day, I told him that my group's members were restless, and I asked him to speak with them. In that teleconference, Michael said there is no such thing as permanent employment in private industry, but that IR had the next best thing.

Celera followed the course advocated by Dyson and found tremendous success, which was not universally well received. Ridiculous papers were published - revisionist histories that reminded me of communist Romania and read like manifestos rather than science.

Once the National Center for Biotechnology Information (NCBI) announced the Human Genome Assembly "finish line," the time was right to evaluate the first human genomes of 2001. At Craig and Michael's request, I became the lead "prosecutor" of Celera's case, with a responsibility as first author of the paper that would put to rest the revisionists' mutterings. A year later, after a tremendous team effort, we published what I call our "lighthouse" paper—computational analysis as permanent as the bricks housing these beacons of light - in the Proceedings of the National Academy of Sciences. Some of the largest biological-inspired computations to date were used for the paper. As was promised in Celera's first paper, the publication of our "lighthouse" paper made public all Celera human genome assemblies and the Celera assembly code, all available in the NIH/NCBI databases.



ABOVE The dream team of authors of the "lighthouse" paper: (standing, left to right) Bjarni Halldorson, Aaron Halpern, Hagit Shatkay, Liliana Florea, Ross Lippert, Nathan Edwards, Granger Sutton, Russell Turner, Craig Venter, Sorin Istrail, Karin Remington, Ian Dew; (sitting, left to right) Clark Mobarry, Brian Walenz, "the Father of all DotPlots," Jason Miller, Merissa Henry.



The Informatics Research Group blazes the way through the bioinformatics jungle, leaving behind a trail of success.

APPLIED BIOSYSTEMS
SPECIAL FORCES

LEFT Front and back images from the Informatics Group t-shirts. Tranquility and Crisium were the two conference rooms of the Informatics Research team. The T-shirts were created to celebrate winning "The Fight for Tranquility."

The Regulatory Genome

After the 2001 publication of the first assemblies of the human genomes, we wondered about the next big problem to solve. Craig told us that drug design was next in line. A remarkable parade of companies presented their technologies to us. Everybody, it seemed, wanted to work with Celera. Craig wanted us to work on the most difficult of cancers: pancreatic cancer.

At that time, I thought the focus of my group should include genomic regulation, because gene regulation is a major component of the disease mechanism. And in this area, the top experimentalist is Caltech's Eric Davidson, whom I had met in Tokyo when he presented a keynote address at a RECOMB conference. At that time, Eric expressed an interest in having Celera sequence the sea urchin. I brought him to Celera to see Craig.

Since then, the most exciting area of my research is my collaboration with Eric on genomic regulatory networks. Our paper "Logic functions of the genomic cis-regulatory code" provided a first repertoire of building block gates of genomic regulation. Eric reeled me in with a story about his mentor, Max Delbruck, his next-door neighbor at Caltech. Max encouraged Eric to start learning mathematics, and even provided a postdoc to teach him. Eric does not tell stories without a motive, so, thinking a bit, I got the message. I told him that I would take the "Delbruck-Davidson challenge" and I would start learning experimental biology. Like his mentor, Eric's students have been my instructors for what he calls my "boot camp training" in wet lab developmental regulatory networks.

Using the sea urchin genome, Eric is today the leading liberator of quantitative principles of cell regulation trapped in the qualitative, descriptive world of biology without genomic sequence. Just like he does in his Caltech Lab, Eric unites all of us—biologists, physicists, biochemists, engineers, and computer scientists—in a research renaissance questing after the functional meaning of DNA. From such research will ultimately come, by experimental demonstration, the revelation of the long-sought laws of regulatory biology.

> "We must emphasize a statement which I am sure you have heard before, but which must be repeated again and again. It is that the sciences do not try to explain, they hardly even try to interpret, they mainly make models. By a model is meant a mathematical construct which, with the addition of certain verbal interpretations, describes the observed phenomena... Furthermore, it must satisfy certain esthetic criteria – that is, in relation to how much it describes, it must be rather simple. ...Once cannot tell exactly how "simple" simple is. ...Simplicity is largely a matter of historical background, of previous conditioning, of antecedents, of customary procedures, and it is very much a function of what is explained by it."
> – John von Neumann

The gene regulatory network models built in the Davidson lab are flagships that satisfy von Neumann's esthetic axiom. These models are updated continuously by the causality-driven scientific method cycle: description-prediction-experimental validation.

For five years, my father dealt with cancer. The doctor taking care of him, Thomas Devers of New Britain, Connecticut, was a physician of extraordinary dedication and professionalism. He was also a fan of Celera. Each time I visited my father in the New Britain Hospital, where he was being treated for advanced pancreatic cancer, the doctor, with a sparkle in his eyes, would ask about Celera. During one of my bedside stays, I told the doctor that I needed to return to work. "Is that OK?" I asked, fearful of what his answer might be. "Go back [to Celera] and save the world," Doctor Devers said. My father passed away a few months later.

Five years earlier, when my father had been diagnosed with pancreatic cancer, an Internet search brought him to surgeon Jeffery Matthews, a doctor affiliated with Harvard Medical School. Doctor Matthews performed an extraordinary procedure to remove the cancerous tissue from my father's pancreas. My father did not believe in impossible problems; he believed there is always a solution—and the harder the problem, the more interesting it was to solve. He survived Romanian Nazi labor camps, and throughout his adult life was a businessman of the highest caliber. One problem he could not solve was his cancer. He was my inspiration.

ABOVE Sorin (right) and Eric Davidson, the Norman Chandler Professor at California Institute of Technology, discuss their ongoing research involving the regulatory genome of sea urchins.

The Axioms

Michael Hunkapiller kept this promise. The IR group survived until the very day he left the company. In industry, once the job is done, it moves on. Nothing personal; just business. All of us in IR moved on as well. Each of us became academics.

I believe von Neumann would have liked each of the four problems discussed in this article. They all have a von Neumannesque flavor in their exceeding difficulty and symbiosis of computer science, biology, physics, statistical mechanics, and mathematical logic. As a computer scientist, it was wonderful to see computer science ready for the Genomic Era. From protein folding and the Ising model to the genome assembly and the regulatory genome, deep biology themes such as evolution, genome structure, biomolecular structure, and cell regulation intertwined with computer science and statistical methods to unveil the genomic mysteries. We need to continue von Neumann's unfinished research program toward a new theory of information and computation for the living cell, in which the "refractory" combinatorics/logic and "best cultivated" analysis come together via a concept of thermodynamic error. Inspired by the cell, we need to uncover the principles of information processing using millions of processors working asynchronously. New computing architecture paradigms based on self-diagnosis and self-repair will help us build von Neumann models for cellular information processing.

My professional ramblings in computational biology have taken me to two Camelots: the National Lab/Sandia; and Celera. Last fall, dressed in academic regalia and listening to President Simmons at Opening Convocation, I realized that I had arrived at another Camelot: Brown. President Simmons spoke with pride about the incoming freshman class, remarking that 15 percent and 13 percent of the class had perfect SAT scores in English and math, respectively. With a back-of-the-envelope calculation guessing that at most 3 percent are perfect in both, it follows that one in four Brown freshman is perfect in either English or math. The students in my "Algorithmic Foundations of Computational Biology" class are extraordinary as well. With such students, plus a department that is a world-class temple for computer science, and the Center for Computational Molecular Biology, which is in the process of recruiting top talent, the sky is the limit.

How do you search for an intellectual Camelot? I believe von Neumann would have liked this question. He would try to find the axioms for it. Based on my experiences, I would venture a guess:

Axiom 1. Randomness is beautiful.
Axiom 2. Work on the hardest problems.
Axiom 3. Continuously search for teachers.
Axiom 4. Scientific teams are fragile.
Axiom 5. A crisis is a terrible thing to waste.
Axiom 6. And in the end, the love you take
is equal to the love you make.

C!

REFERENCES

1. John von Neumann, The Mathematician, in "The Works of the Mind" U. of Chicago Press, (1947), pp. 180-196

2. John von Neumann, Method in Physical Sciences, in "The Unity of Knowledge", ed. L. Leary (1955), pp. 157-164

3. John von Neumann, Probabilistic Logics and the Synthesis of Reliable Organisms from Unreliable Components," in "Automata Studies", eds. C. E. Shannon and J. McCarthy (1956), pp. 43-98

4. William E. Hart, Sorin Istrail, Fast Protein Folding in the Hydrophobic-Hydrophilic Model Within Three-eighths of Optimal (Extended Abstract), Proceedings of 27th Annual ACM Symposium on Theory of Computation (STOC95), ACM Press (1995) pp. 157-168

5. Sorin Istrail, Statistical Mechanics, Three-Dimensionality and NP-Completeness: I. Universality of Intractability of the Partition Functions of the Ising Model Across Non-Planar Lattices, Proceedings of the 32nd ACM Symposium on the Theory of Computing (STOC00)}, Portland, Oregon, May 21-23, ACM Press, (2000) p. 87-96

6. Sorin Istrail, Granger G. Sutton, Liliana Florea, Aaron L. Halpern, Clark M. Mobarry, Ross Lippert, Brian Walenz, Hagit Shatkay, Ian Dew, Jason R. Miller, Michael J. Flanigan, Nathan J. Edwards, Randall Bolanos, Daniel Fasulo, Bjarni V. Halldorsson, Sridhar Hannenhalli, Russell Turner, Shibu Yooseph, Fu Lu, Deborah R. Nusskern, Bixiong Chris Shue, Xiangqun, Holly Zheng, Fei Zhong, Arthur L. Delcher, Daniel H. Huson, Saul A. Kravitz, Laurent Mouchard, Knut Reinert, Karin A. Remington, Andrew G. Clark, Michael S. Waterman, Evan E. Eichler, Mark D. Adams, Michael W. Hunkapiller, Eugene W. Myers, J. Craig Venter, Whole Genome Shotgun Assembly and Comparison of Human Genome Assemblies, Proceedings of the National Academy of Sciences (2004) vol. 101, No. 7, pp. 1916-1921,

7. Sorin Istrail and Eric Davidson, Logic functions of the genomic cis-regulatory code, Proceedings of the National Academy of Sciences (2005) vol. 102, No. 14, pp. 4954-4959

8. Available at http://www.cs.brown.edu/people/sorin/ising.htm

· Barry Cipra, MATHEMATICS: Statistical Physicists Phase Out a Dream, Science , vol. 288, pp. 5471, June 2, 2000,

· Philip Ball, PHYSICS: The Ising on the Cake, Nature, April 26, 2000

· Barry Cipra, The Ising Model is NP-complete, vol. 33, No. 6, SIAM News, 2000

· Neal Singer, Why, in Superbowl of statistical mechanics, famous players could never cross goal line (Three-dimensional proof for Ising model impossible, Sandia researcher claims), Sandia Labs News, April 24, 2000

Michael Black

Michael attended the International Conference on Computer Vision in Beijing where he and Ph.D. student Stefan Roth received honorable mention for the Marr Prize in Vision. The awards were given at a traditional banquet held in the Great Hall of the People (see below). Less traditional was the espresso at Starbucks inside the Forbidden City (see right).

Other fall/winter food highlights included sublime strudel in Vienna and "vogerlsalat" in Graz (salad of lamb's lettuce, warm potatoes and pumpkin oil) while attending the area chair meeting for the European Conference on Computer Vision; dark wheat beer at Hoftbrauhaus in Munich and leberkase ("liver cheese") in a Bavarian monastery while visiting the German Aerospace Center (DLR). Brown and DLR will collaborate on the neural prosthetic control of DLR's advanced robot hand. The leberkase confirmed Michael's reputation as a "flexitarian". The best food (and wine) in the last few months however was in Lucca, Italy where Michael stayed while attending the First International Conference on Biorobotics in Pisa.

Michael gave a number of invited talks over the last few months including a talk on "Bayesian Denoising of Archival Films" at the Workshop on The Mathematics and Art of Film Editing and Restoration held at the Institute for Mathematics and its Applications at the University of Minnesota. The meeting brought together film archivists, restoration experts, special effects artists, computer scientists and mathematicians.

Back in Providence, Michael had two new post-doctoral researchers join his group: Sung-Phil Kim and Gregory Shakhnarovich, both of whom are working on machine learning methods for neural prostheses.

New funding over the last few months comes from generous gifts from Honda Research, Intel Corporation and an NSF grant with Tom Dean and Chad Jenkins on "Statistical Models of the Primate Neocortex."

In February, Michael became an associate of the Canadian Institute of Advanced Research.

Roger Blumberg

Roger has been on leave this semester, working on two projects. The first is a new (7th) edition of MendelWeb (www.mendelweb.org), which will include several new essays and will be finished later this year. Recently, Roger was asked to contribute the entry on "Mendel's Law" for the 2nd edition of the International Encyclopedia of the Social Sciences (published by MacMillan). The second project sounds similarly remote from computing concerns, but isn't entirely. Roger has been researching the Mohawk Indian occupation of Moss Lake, New York, from 1974-1977, for a book about how a local "crisis" was handled and represented in the days before cable news (B.C.NN.?)

David Durand

This year David and Andy have been advising Noah Wardrip-Fruin, who is doing an independent Ph.D. in digital literature and is expected to defend his dissertation this spring. In 2004, Noah and David had collaborated on two works of net art, *Regime Change* and *News Reader*, for Turbulence (turbulence.org), and in 2005 David presented *CardPlay*, another collaboration with Noah, as a work-in-progress, at the Association for Computing in the Humanities' annual conference. In another literary area, he has been collaborating with Daniel Howe, digital writer in residence in literary arts, on poetry generation.

He has also been working with two visitors from the University of Bologna, Angelo Dilorio and Stefano Zacchiroli on change and consistency management in domain-specific Wikis.

Outside the University, David has been very busy! He quit his old day job at Ingenta, and is starting a new company, Tizra, with a group of other ex-Ingenta employees. They will be providing publisher commerce services for management, delivery and sale of online digital products. They are still in the early stages, but check tizra.com for an RSS feed if you are interested in seeing what happens.

Amy Greenwald

Amy's been on sabbatical and using the time to write a book on the Trading Agent Competition (TAC), specifically TAC Travel.

She also received a grant from NSF for $363K with Ph.D. candidate John Wicks entitled, "Efficient Link Analysis: A Hierarchical Voting System." The grant will further their development of QuickRank, a recursive algorithm for ranking nodes in a social network with inherent hierarchical structure. Examples of these networks include the Web or the Enron email database.

Last, but certainly not least, Amy received a 2006 Sloan Research Fellowship for her work with "AI agents" —artificially intelligent, programmed decision-makers. See page 20 for the full story.

John Hughes

I've been teaching an experimental version of CS4 using Matlab, in hope that this is something that most engineering students (and others who take CS4) will use more in their work than C. So far it's working well. The development environment and toolkits are just about perfect, however, the language makes me wish they'd talked to someone who knew languages before they designed it. :-(

Chad Jenkins

Chad developed a new course, CS196-2 "Innovating Game Development", focusing on games research, i.e., technological advancements at the intersection of interactive entertainment and computer science. This course featured a speaker series with guest lectures given by CS researchers as well as game development professionals from companies such as Harmonix, Demiurge, and Mad Doc.

Along with Meinolf Sellman, Chad was awarded a Salomon grant to fund the Brown robot soccer team to compete in Robocup.

Shriram Krishnamurthi

I attended a meeting of IFIP Working Group 2.3, held in Flemish Belgium in March. The group's meetings have been extraordinarily educational as I try to better understand software specification. I was thrilled to be invited to join the group as a member.

Flanders in the spring also has a special place in the hearts of cycling fans. I enjoyed my time on two wheels, riding on wind-swept roads lined by canals and poplars and frequently juddering over cobbles . I visited a delightful, obscure little museum in Oudenaarde dedicated to the Ronde Van Vlaanderen (a classic spring race). Best of all, I had a chance to ride in the Flemish Ardennes up the narrow, rutted, cobbled road that negotiates the fabled Muur ("wall") of Geraardsbergen (see right).

David Laidlaw

David continues working on scientific visualization problems and is moving into a new application area of interactive tools for genomics and proteomics. Also, he and his colleagues received both Brown seed funding and major NIH funding this year to work on brain imaging and image analysis.

Traveling and speaking during 2005 was plentiful (although he didn't come close to keeping up with Michael Black). He spoke at the Image and Meaning 2 Conference in LA, VRVis in Vienna, a Dagstuhl seminar in Germany, the German-American Frontiers of Engineering Symposium in Potsdam (organized by the National Academy of Engineering), the Visualization Conference, and the annual AAAS meeting.

Barbara Meier

I have developed a second course in computer animation production which will be taught in spring '06-07. The new course will give students an opportunity to explore the technical and artistic aspects of animation in greater depth. In an effort to recruit students early, I am introducing kindergarten through 3rd graders to computer animation at a lunch time talk at our son's school. We explore visual effects by creating a movie in which a spaceship lands on the school and a robot alien convinces the principal to give the kids extra recess.

John Savage

John Savage published two journal articles in 2005 since the last issue of *Conduit*, "Evaluation of Design Strategies for Stochastically Assembled Nanoarray Memories" with Eric Rachlin '03 and Benjamin Gojman '05 that appeared in the *ACM Journal on Emerging Technologies in Computing Systems* and "Efficient Data Storage in Large Nanoarrays" with Lee-Ad Gottlieb '01 and Arkady Yerukhimovich '03 that appeared in *Theory of Computing Systems*. He has also published two conference articles with Eric Rachlin, one in the Proceedings of TECHCON 2005 entitled "Crossbar Addressing Using Core-Shell Nanowires" in October, 2005 and another in the Proceedings of the International Symposium on VLSI in March 2006 entitled "Addressing in the Face of Uncertainty."

John is also a co-author of two patents on nanotechnology issued in 2005, both with A. DeHon, C.M. Lieber, and P. Lincoln. They are entitled "Stochastic Assembly of Sublithographic Nanoscale Interfaces" and "Sublithographic Nanoscale Memory Architectures."

John gave two invited talks, one at ICCAD in November 2005 entitled "Analysis of Stochastically Assembled Arrays" and one at HPC Nano05 in November, 2005 entitled "Computational Nanotechnology—An Introduction." In addition, he served as a member of the steering and program committees of HPC Nano05.

In the computer science department, John chairs the curriculum committee which is reviewing our undergraduate A.B. and Sc.B. concentrations. He chaired the search committee to hire an executive officer to replace Trina Avery that convened in late 2005 and early 2006. At the University level, he sits on the faculty capital campaign committee whose role is to communicate with the faculty about the campaign and advise the administration and development office. In the fall, John taught a new course entitled "Introduction to Nanocomputing."

Meinolf Sellmann

Last fall, I attended CP 2005 in Barcelona, Spain, to present a novel approximation algorithm on automatic recording that can also serve as a basis for constraint propagation. During CP 2005, I was also invited to speak on a panel regarding the past and future of constraint programming. However, the most exciting event of this trip was

proposing to my long-term girlfriend who agreed to marry me this June in Germany. During the conference, Professor Pascal Van Hentenryck and I also used the opportunity to conduct a meeting of STINT, an ongoing collaboration project of the Brown CS department and our friends and colleagues in Uppsala, Sweden. As a result, I visited Uppsala University in November to deliver a talk on symmetry breaking and to foster the collaboration further. While I am writing these notes, Justin Pearson from Uppsala University is on his way to Brown to repay my visit. Together with Pascal and Professor Pierre Flener, we are currently working on a joint submission for CP 2006.

Two papers were accepted at CPAIOR 2006 in Cork, Ireland: One was prepared in close collaboration with Professor Claire Kenyon that studies when the idea of providing back-up plans in case of uncertain future scenarios can actually work. The other is the fruit of a collaboration with graduate student Ionut Aron and undergraduate Daniel Leventhal on a polyhedral analysis of consistent value polytopes for binary constraint programs.

During the Informs conference in San Francisco (see below) in November '05, I was offered to serve as associate editor for the *Informs Journal on Computing*, which I gladly accepted. Finally, Professor Laurent Michel's and my proposal to host the CP conference at Brown in 2007 was kindly accepted by the Association of Constraint Programming. Now I find myself very busy preparing the conference, the move of my furniture from Germany, and of course, my wedding and honeymoon!

Anne Morgan Spalter

Anne has been busy with three new grants, all of which are related to her work on digital visual literacy (DVL). The main grant is through the NSF Advanced Technology Education (ATE) program and is a collaboration with Mesa Community College in Arizona. Mesa Community College is the largest in the Maricopa county system, which has over 280,000 students. Andy van Dam is the Brown PI and Anne is the co-PI. The first semester of the grant has been busy with trips to Arizona, teaching faculty in the Maricopa system the basics of computer graphics, and working to produce modular curricular materials. The first round of courses using these modules has already begun, with hundreds of students participating this spring. The grant is honored to have an exemplary advisory board, which includes John Seely Brown, David Salesin and Scott Anderson. Other members from the local community include RISD President Roger Mandle.

The second grant, which is through the NSF Broadening Participation in Computing (BPC) program, supplements both the ATE and Andy's ITR (the immune attack project, described in his notes). The goal of the grant is to bring creative students into the department who would otherwise not have considered taking CS courses. The grant provides funding for students interested in design (many of whom are female) to work with CS and other science faculty providing design assistance for everything from PowerPoint presentations to article images to actual visual research. Anne ran a workshop for the student participants during the first part of the spring semester that covered relevant topics in computer graphics and perception, as well as some basic design guidelines.

Finally, a grant by Sun Microsystems, Inc. has provided funds to continue work on the Graphics Teaching Tool (GTT), a Java-based graphics environment designed for use in teaching graphics concepts to non-technical students. The GTT was used in CS24 and will also be used in the ATE grant. Anne and the GTT's co-creator, Ph.D. student Dana Tenneson (who brought the GTT ideas to life as a master's project), will be presenting an education paper on the GTT at this year's SIGGRAPH conference in Boston. (The GTT software and related materials can be found at http://graphics.cs.brown.edu/research/gtt/.)

This winter, Anne gave a talk on DVL at Harvard in a seminar series held by the new Initiative for Innovative Computing (IIC). She was also a reviewer for the SIGGRAPH 2006 juried art show.

Roberto Tamassia

Roberto Tamassia continued his collaboration with IAM Technology on the development of novel distributed authentication methods. In the context of this collaboration, he received a $678,000 grant from IAM Technology in support of research on "Efficient Authentication of Internet Applications." Team members for this project include Ph.D. candidates Charalampos Papamanthou, Nikos Triandopoulos and Danfeng Yao, undergraduate student David Ellis, and long-time research collaborator Michael Goodrich (now at the University of California, Irvine). The results from this project have resulted in two patent applications in addition to several papers.

Roberto's textbook, *Data Structures and Algorithms in Java*, coauthored with Michael Goodrich, is now in its fourth edition. Revisions include incorporating generics in the programming examples. Generics are a new feature of the Java programming language allowing to define parameterized types.

Roberto started teaching CS166, a new course that addresses the security of computer systems and networks. In addition to graduate teaching assistant Danfeng Yao, the course staff includes undergraduate TAs Mike "Ace Trojan" Shim (head TA), Jimmy "Rice Pudding" Kaplowitz, Leo "Chubbs" Meyerovich, Aurojit "Le Panda" Panda, and Joel "Mess With the Best, Die Like the Rest" Weinberger. Topics covered in the course also include cryptography and physical security. Beware of the students who completed the course. Not only can they crack your passwords and transform your computer into a zombie, but they can also pick the locks of your home, open the safes of your bank, and if in a really bad mood, cause the entire Internet to grind to a halt.

Due to his extensive travels to attend conferences, committee and panel meetings, and give seminars, Roberto qualified for the fifth year in a row as an American Airlines Executive Platinum member, the highest elite tier of American's frequent flyers. Besides unlimited upgrades to first class, his perks include the ability to book a confirmed seat on a full flight. He doesn't get to choose the passenger to bump, though. In between his trips, Roberto enjoys his new house on College Hill which features an award-winning design by local architectural firm Bay+Bay and whose unique contemporary architecture features curved external walls, exposed

steel beams, and a puzzling inward-sloping roof.

Eli Upfal

Eli Upfal was named fellow of the ACM for "contributions to parallel and stochastic networks." He also received an IBM faculty award for his work on modeling the web graph.

Eli spent the winter vacation in Israel, where there is no winter to speak of and no winter vacation. Eli visited and gave talks at three universities there: The Weizmann Institute where he had been a professor many years ago, the Hebrew University where he received his B.Sc. and Ph.D. even more years ago, and Tel Aviv University.

Andy van Dam

Andy started his forty-first year at Brown by inaugurating his new book, co-authored with Brown alumnus Dr. Kate Sanders entitled *Object Oriented Programming in Java* in CS15. This book has been based on lots of creative ideas from former undergraduate students who TA'd the course, starting with Brook Conner and Robert Duvall.

He invited his RSI hand-surgeon, Dr. Peter Weiss, to lecture on computers and RSI problems related to keyboarding. Dr. Weiss offered valuable advice for ways to prevent and correct problems from long-term computer use.

In the past six months, Andy has also hosted Brown alumni Michael Rubin (*Droidmaker: George Lucas and the Digital Revolution*) and Andy Hertzfeld (*Revolution in the Valley, the Insanely Great Story of how the Mac Was Made* see right) who both gave compelling, often amusing guest lectures on their recent books. In addition, Andy invited DreamWorks SKG co-founder Jeffrey Katzenberg and alumnus Jeff Beall to visit Brown as part of an outreach program. Mr. Katzenberg held an informal question and answer meeting with students from Brown and RISD, answering their questions on the trends in computer animation and the best ways to break into the moviemaking industry.

Andy and his research team have also been hard at work with teams from FAS (Federation of American Scientists) and USC on an educational video game for teaching immunology to high school AP biology students that is being developed under funding from an NSF grant. Testing begins in late April. This is an example of a "serious game", not a twitch game, in that students are required to specify the rules of defenders and thereby learn the body's many and complex immune response mechanisms. Brown is responsible for much of the programming and visualization, under the leadership of graphics researcher Loring Holden.

Since October, Andy has given guest lectures at The College of William and Mary, the University of Texas, Simon Since October, Andy has given guest lectures at The College of William and Mary, the University of Texas, Simon Frasier University and Harvard University. The lecture at Harvard University, as part of their Initiative in Innovative Computing program, was directly related to research he has been conducting with Anne Spalter on digital visual literacy as part of an NSF Advanced Technology Education (ATE) grant in collaboration with Drs. Pinny Sheoran and Oris Friesen from the Mesa Community College system.

Capping off this busy time, Andy has been named the director of the pen-centric research center Microsoft is sponsoring at Brown (see page 21). The Microsoft Center for Research on Pen-Centric Computing is the first of its kind and will be focusing on ways to make using computers easier for scientists, artists and others who routinely use handwriting and sketching to create and communicate digitally. In March, Rick Rashid, senior vice president of research for Microsoft, inaugurated the $1.2 million research center and spoke on how to conduct research in a global research market.

Pascal Van Hentenryck

Pascal Van Hentenryck was elected as an officer of INFORMS ICS, the computer science section of INFORMS. He was also program chair of PADL'06, the international symposium on practical aspects of declarative languages (Shriram was program chair of the same symposium a couple of years ago!). He will give invited talks at UAI'06, the International Conference on Uncertainty in Artificial Intelligence and at AI'06, the Canadian Conference on Artificial Intelligence this summer, as well as a tutorial on his Comet system at AAAI'06.

Peter Wegner

Dina and I will publish an edited book on interactive computing through Springer Verlag later this year with 18 articles by well known computer scientists, including Robin Milner.

The ACM has invited me to propose a new editor of *Computing Surveys* to take over when the current editor retires this summer.

I continue to edit the *Brown Faculty Bulletin* and am working on the next issue to be published this May, prior to commencement. **C!**

LEFT Tom Doeppner photographed this male Banded Jawfish (Opistognathus macrognathus) in the waters off of St. Vincent this past January. In its mouth are fertilized eggs, which the fish will hold on to and take care of until they hatch (one hopes soon).

Faculty Awards and Honors

ABOVE Ph.D. candidate Stefan Roth (left) and Professor Michael Black (right) won Honorable Mention for the Marr Prize in Vision at this year's International Conference on Computer Vision (ICCV).
BELOW Assistant Professors Chad Jenkins (left) and Meinolf Sellman (right) were chosen to receive one of Brown's highly selective Salomon Awards.

Herlihy and Upfal Named ACM Fellows

The Association for Computing Machinery (ACM) has recognized 34 of its members for their contributions to both the practical and theoretical aspects of computing and information technology. The new ACM Fellows, from some of the world's leading industries, research labs, and universities made significant advances that are having lasting effects on the lives of citizens throughout the world.

Brown Computer Science garnered two Fellows this year. Professor Maurice Herlihy was recognized for his contributions to distributed and parallel systems and Professor and Department Chair Eli Upfal for his contributions to parallel and stochastic networks.

"These individuals deserve our acclaim for their dedication, creativity, and success in pursuing productive careers in information technology," said ACM President David Patterson. "By seizing these opportunities, they demonstrate the astonishing potential for innovation in the computing discipline, and the broad-based, profound and enduring impacts of their achievements for the way we live and work in the 21st Century. On a personal note, I am pleased that I've known and collaborated with many of these new fellows for several years."

ACM will formally recognize the new Fellows at its annual awards banquet on May 20, 2006, in San Francisco, CA. Additional information about the ACM 2005 Fellows, the awards event, as well as previous ACM Fellows and award winners is available at www.acm.org/awards. **C!**

Amy Greenwald Receives Sloan Research Fellowship

Assistant Professor Amy Greenwald has received a 2006 Sloan Research Fellowship for her work with "AI agents"—artificially intelligent, programmed decision-makers. Amy's research in simultaneous and sequential auction environments combines the theoretical and practical, and draws from and contributes to a variety of disciplines including AI, decision theory, game theory, and economics. She is a member of the board of trustees and a six-time finalist in the annual, international Trading Agent Competition (TAC).

The Sloan Research Fellowships were established in 1955 to provide support and recognition to early-career scientists and scholars. Selection procedures are designed to identify those who show the most outstanding promise of making fundamental contributions to new knowledge. Sloan Research Fellows, once chosen, are free to pursue whatever lines of inquiry are of the most compelling interest to them.

In addition to the monetary aspect of the fellowship and recognition of her distinguished performance, Amy has now increased her chances of receiving another prestigious award—thirty-two Sloan Fellows have won Nobel Prizes later in their careers. **C!**

Salomon Award to Jenkins and Sellmann

Assistant Professors Chad Jenkins and Meinolf Sellmann have been selected to receive one of Brown's highly competitive Salomon Awards. The $30,000 grant will support research projects in time-critical decision making and robot learning from demonstration. Their research in this area will be applied to the robot soccer domain through participation in the Robocup competition this summer. This work will increase the accessibility of controlling robots to greater numbers of people through developing methods for learning basic robot skills from human demonstration. These skills are the basis for research into time-critical optimization to allow robots to reason as close to optimal with limited resources and time. For more information about this project, see "Learning Autonomous Robot Control from Demonstration" on page 4. **C!**

Marr Vision Award to Black and Roth

Ph.D. candidate Stefan Roth and Professor Michael Black won Honorable Mention for the Marr Prize in Vision for their paper, "On the Spatial Statistics of Optical Flow" at this year's International Conference on Computer Vision (ICCV).

The Marr Prize is named in honor of David Marr and is considered the most prestigious award in computer vision and is given for the best paper(s) at ICCV. The conference received approximately 1200 submissions from which there was one prize winner and three papers that received honorable mention. **C!**

Microsoft Center for Research on Pen-Centric Computing

Computer Graphics Group

The Brown computer graphics group has been at the vanguard of pen-centric computing for over a decade, gaining widespread recognition for achievements in pen-based interfaces for sketching 3D models, writing music, and creating interactive sketches of mathematics and molecules. More recently, Microsoft supported the pen-centric computing vision both through its creation of the TabletPC platform and through a series of gifts to the graphics group to pursue research in core technologies and applications in pen-centric computing. On March 20, 2006, these two paths formally converged through the inauguration of the Microsoft Center for Research on Pen-Centric Computing, which will be housed in the computer science department.

"Pen-based computing has the potential to alter the way students and teachers interact... positively affecting not only the educational process but our working methods and our culture."

Andy van Dam, the director of the center, believes that "in some cases, the pen is mightier than the keyboard." However, the challenge for the center is to show that pen-based computer interfaces, not just pencil and paper, have a proper place alongside keyboard and mouse interfaces in the work flow of people ranging from scientists to artists. Imagine, for instance, attending an introductory biochemistry class in which 2D chemical notations on an electronic whiteboard were instantly transformed into interactive displays of 3D molecules, or responding to a stroke of musical inspiration by jotting down conventional music scorings on a PDA that could interpret the handwritten notation for instant playback or structured editing. As Dr. Rick Rashid, senior vice president of research at Microsoft, noted during the inauguration, "pen-based computing has the potential to alter the way students and teachers interact… positively affecting not only the educational process but our working methods and our culture."

van Dam's team of full-time researchers and students, including Bob Zeleznik, Tim Miller, Joe LaViola, Dana Tenneson, Andy Forsberg and Christopher Maloney, have made a good start to realizing this vision. Together, with support from Microsoft, Brown and NSF, they established a portfolio of high-profile pen-based applications. ChemPad, a TabletPC application for visualizing molecules, was enthusiastically received by students in Brown Chemistry Professor Matt Zimmt's introductory Organic Chemistry course. Music Notepad, a TabletPC PowerToy demonstration project previously sponsored by Microsoft, has been downloaded by students and professionals around the world and even incorporated into the curriculum in one high school. Other projects, like MathPad2 and Geompad have similar potential, although they highlight the need for improvements in fundamental pen-centric technologies and recognition algorithms, both focal points of the center's future research.

The press release announcing Microsoft Research's decision to fund the research center with up to $1.2 million over the next three years was picked up in the local papers and on local TV stations, as well in *USA Today* and on wire services such as the AP and Metro Networks. To more fully realize the center's vision, van Dam anticipates the opportunity for additional funding from federal and state government, among others, to deploy and evaluate the center's technology in the workplace as well as classroom settings. **C!**

Further information:

http://graphics.cs.brown.edu/research/pcc

ABOVE The inauguration celebration included a round-table discussion for graduate students. Featured in the photo are Rick Rashid, Andy van Dam and Ph.D. candidate Dana Tenneson.

Remembering Paris: The Kanellakis Fellowships

Nikos Triandopoulos is a Brown Ph.D. candidate and Kanellakis Fellow. **Alex Shvartsman** is an associate professor at the University of Connecticut and a former colleague of Paris Kanellakis.

TOP Paris was an esteemed member of our faculty working on theoretical computer science. In this photo, Paris is standing as part of our theory team with (from left to right): Professor Jeff Vitter (currently Dean of Science at Purdue University) and Professors John Savage, Roberto Tamassia, Phillip Klein, Paris and Franco Preparata. **BOTTOM** Professor Richard Karp with Kanellakis Fellows and Greek students from Brown and MIT after the 5th Annual Paris Kanellakis lecture on December 8th, 2005.

It has been ten years since the sudden and untimely death of Paris Kanellakis, a Brown computer science faculty member, in an airplane crash in December, 1995, along with his wife Maria-Teresa and their two children, Alexandra and Stephanos. The tragic event was a tremendous loss in both the scientific community and our department. Paris was a distinguished computer scientist, recognized for his contributions in theoretical computer science, especially in the area of database systems, where he was the founder of constrained databases, but also in the areas of logic in computer science, distributed computing and combinatorial optimization. He had always been a pioneer in his work, which had impact on many aspects of computer science and influenced many different research directions. But Paris was also distinguished by his personality. People who knew him as a colleague or a friend always talk about a lovable and engaging person, full of life and energy, with a nice sense of humor and a touch of sophistication.

To keep their son's memory alive, Paris' parents, General and Mrs. Eleftherios Kanellakis have generously donated funds to Brown University for two special Kanellakis graduate fellowships, which are awarded to new and current Ph.D. students. It is the wish of General and Mrs. Kanellakis, that the department award these fellowships to students from Greece whenever possible. The Kanellakis fellowships were established the following year and have been continuously awarded to students since 1997. The Kanellakis family also made donations to MIT, where Paris received his Ph.D. in computer science, and to the National Technical University of Athens, where Paris did his undergraduate work.

Alex Shvartsman, associate professor at the University of Connecticut, and a former colleague, had a key role in establishing the Kanellakis fellowship program and remembers some of the details behind this effort, even though, he admits recalling these memories is still difficult 10 years later… "Following the tragic and devastating accident on December 20, 1995," he remembers, "there was a University-wide memorial service for the Kanellakis family at Brown in January, 1996. Mrs. Kanellakis came from Greece to attend the service…When I met Rula at the airport in Providence, she said that Paris advised them to talk to me if they needed anything. During her visit, Mrs. Kanellakis said several times that she and Mr. Kanellakis said 'we have no hope, but we want to give hope to others.'"

In the fall of 1996, Paris' parents worked with Alex Shvartsman, professors John Guttag and Paul Sclavunos of MIT, the Brown Development Office, computer science professors Eugene Charniak and Franco Preparata and President Gregorian to create three graduate fellowships—two at Brown and one at MIT. Under the notion of "giving hope to others," the family chose to create graduate fellowships to help young people who, like Paris at MIT in 1970s, are at the beginning of their professional lives with many challenges ahead of them. The fellowships were established during the 1997-1998 academic year.

"The Kanellakis fellowship is a wonderful thing," comments Eli Upfal, department chair, "that benefits our Ph.D. program by assisting the fellows in their first academic steps and by attracting bright young candidates." Our department is grateful to the Kanellakis family for this gift that not only honors the memory and accomplishments of Paris, but also creates new opportunities for students to pursue graduate studies. The Kanellakis fellowship does, indeed, give hope to others.

The department has awarded the fellowship to many students including Manos Renieris, Ioannis Tsochantaridis, Costas Busch, Aris Anagnostopoulos, Nikos Triandopoulos, Olga Papaemmanouil, Alexandru Balan, Yannis Vergados and Tomer Moscovich. Three of the Kanellakis fellowship recipients have already graduated. Costas Busch received his Ph.D. in 2000 with a thesis titled "A Study on Distributed Structures" and he is currently an assistant professor at RPI. Manos Renieris received his Ph.D. in 2005 with a thesis titled

"A Research Framework for Software-Fault Localization Tools" and is currently at Google. Ioannis Tsochantaridis received his Ph.D. with a thesis titled "Support Vector Machine Learning for Interdependent and Structured Output Spaces" and is currently at Google Research. Other fellows are expected to finish their Ph.D. requirements this year.

Since 1999, a Kanellakis fellowship for graduate studies has been awarded at MIT. The recipients are: Manolis Kellis (Kamvysselis), Christos Kapoutsis, Aristeidis Karalis, Mario Christoudias, Anastasios Sidiropoulos, Nikos Andrikogannopoulos and Apostolos Fertis. Manolis Kellis graduated and is now an assistant professor at MIT.

"People who knew him as a colleague or friend always talk about a lovable and engaging person, full of life and energy..."

Many of the recipients have personally met with General and Mrs. Kanellakis and try to visit them during every trip to Greece. They all agree that they are wonderful people and over the years have built a special relationship which helps them learn more about Paris' academic and social lives making them feel connected to Paris without having met him. Paris' academic legacy and his commitment to all aspects of life is an excellent example in pursuing their individual careers and why they feel honored to have received the Kanellakis fellowship.

To honor Paris Kanellakis' achievements and memorialize his presence at Brown, our department has initiated the Kanellakis Lectures, a series of lectures given each December by distinguished researchers in computer science. Last year's lecture was given by Professor Richard Karp from UC, Berkeley on "Geometric Optics, Linear Programming and Congestion in Sensornets." Previous lecturers have included: Professor Mihalis Yannakakis of Columbia in 2001, Professor Christos Papadimitriou of UC, Berkeley in 2002, Professor Nancy Lynch of MIT in 2003 (talk given by Alex Shvartsman) and Professor Michael O. Rabin of Harvard in 2004. All lectures have been well attended and bring together current students, faculty and alumni. **C!**

Wandering the Web

Wandering the Web is a new column featuring recommended web resources and diversions from a member of the faculty. This issue's inaugural contributor is none other than Associate Professor John "Spike" Hughes.

Not only do the faculty read books, they also spend time wandering the web. Here's where I've been poking around in the last few months, with brief comments:

www.thedailywtf.com: A source of constant hilarity, disgust, and dismay. Examples of hideous code from production software, with commentary from readers. My favorite comment so far: "I believe I am being only slightly off topic when I ask if anyone knows how to stop bleeding from the eyes." I pray that none of my students' code ever appears here.

http://journal.bookfinder.com/: If you haven't found Bookfinder.com, you've missed a treat. Pedestrian interface, amazing quality. Find those books you always wished you had. I've used it to locate a nice copy of "The Life and Letters of John Hay," "A Textbook of Topology," by Seifert and Threlfall, and "Curious Naturalists," by Niko Tinbergen.. Also good for finding that book you loved as a kid, but haven't seen in many years. The "journal" part is book-related news, and discussion about running the Bookfinder business.

www.planarity.net: A student project that's completely addictive.

members.shaw.ca/sonde/: A guy who wanted to fly a radio-controlled (sort of) plane very high. His glider is lifted by a weather balloon, with a pre-programmed altitude release. Using GPS, etc, it then tries to fly itself back to the general vicinity of the launch, taking pictures along the way. When it gets close enough, he can control it with a standard radio-controlled setup. Onboard is a small computer running DOS, but mostly it's C code that does the work. Now this would be a great CS190 project.

www.michaelbach.de/ot/mot_mib/: An amazing "optical illusion." Michael Bach has produced an unbelievable collection of illustrations of these, easily reachable from the URL above. This particular one shows how one moving object can cause other continually visible objects to disappear from view
(in the sense that your brain no longer recognizes their presence). **C!**

Managing the Fire Hose: High-Speed Data Stream Processing Industrial Partners Program Symposium 2005

Professor **Stan Zdonik**'s research focuses on database systems, query processing, and data dissemination. His recent energies have been spent on Borealis, a second generation stream processing engine.

The department's 35th Industrial Partners Program (IPP) Symposium focused on the emerging area of high-speed data stream processing.

In any modern enterprise, the rate at which data must be ingested and acted on intelligently is increasing rapidly. This is a result of better methods of data collection, higher speed communications, and the heavy demands of today's business environment. Keeping up with this torrent of information is a constant challenge for any advanced IT team. The technical problems include the integration of many heterogeneous data sources, sophisticated data mining and analysis, and the need for near real-time response.

ABOVE Symposium participants included: (top row) Ugur Cetintemel, Sam Madden, Stan Zdonik, Mark Truman, (bottom row) Rob Strom, Chitra Dorai and Yuanyuan Zhao (from IBM).
Missing from photo: Adam Stauffer

At the same time, stored data is inappropriate in many of these applications. In stock ticker applications, industrial process control, and sensor-based environmental monitoring, for instance, data loses its value so quickly that by the time it is stored, it is stale. Instead, the live data must be processed as it is being collected.

Conventional data management techniques fall far short in these settings. Research labs and universities are working on advanced tools to address real-time enterprise and sensor processing. Products such as faster data warehouses, stream processing engines, and business intelligence tools are beginning to appear in the marketplace, but much more work is necessary.

The day was divided into a morning session on modern applications and the problems that they present to the rapid real-time processing of time-critical data, and an afternoon session on technologies that try to address some of these problems. The symposium examined some of these problems from various perspectives.

Applications

In the morning, we heard from Mark Truman from GTECH, a Providence-based company and the world leader in electronic gaming and lottery system deployment. Lottery systems have quite unusual technical requirements of sub-second Server-over-WAN response time at a sustained demand of thousands of TPS. Moreover, reliability in this environment must be extraordinarily high because of contractual uncapped liquidated damages of thousands of dollars per minute of downtime.

Mark talked about how this requirement for uncompromised reliability, security, and performance makes it unreasonable for them to deploy off-the-shelf solutions. He discussed how GTECH has addressed these problems by building a set of in-house solutions that match their needs more precisely than what they could find in the marketplace. Doing a small number of things well with a sharp focus on resource allocation is crucial to their technical and business success.

Mark's presentation outlined these constraints and discussed in detail what GTECH has done to thrive. He went into depth on the architectural and design principles resulting from these constraints. He outlined some of the traps to avoid, and he addressed the issue of whether or not a TP system performs in a deterministic manner across a wide rage of demands and still be affordable.

The morning session concluded with a talk from Adam Stauffer, a Brown CS grad and currently the CTO of HBK Investments, a hedge fund located in Texas. As in most industries, computer technology has radically changed the face of the financial markets. By some estimates, more than half of the trades in the US equity markets are software trading with software. The US market alone generates five gigabytes of new data every day. Adam's presentation gave us an overview of the business and regulatory issues that are driving the industry's software requirements. He also provided an overview of the technologies that are allowing market participants to process and understand this flood of information.

Technologies

The afternoon session began with a talk from Rob Strom of the IBM T.J. Watson Research Center, titled "Smart Middleware and Light Ends (SMILE) for Simplifying Data Integration," SMILE is a stateful

publish-subscribe system that allows subscribers to request continually updated derived views, specified as relational algebra expressions over published data streams. The derived views can be specified using aggregations, joins, and other transforms. The goals of the SMILE project are to replace the labor-intensive and error-prone writing of low-level stateful message transforms with declarative specifications while providing the speed, scalability, and reliability of messaging systems. SMILE achieves this for applications that do not require ACID properties but only require that the information they receive is never false and arrives eventually. Rob formalized this by introducing an "eventual correctness" guarantee and showed how the current implementation enforces it using a monotonic type system.

The second talk of the afternoon was by Ugur Cetintemel, from the Brown Computer Science department, who spoke about some novel new technologies that are being developed at Brown for dealing with high-speed data streams. Many existing and newly emerging applications require sophisticated, timely processing and distribution of high-speed data streams. However, existing software platforms fall short of meeting the scalability, availability, and performance requirements of these applications. Thus, a new generic software infrastructure is needed.

Ugur provided an overview of recent work on two such software infrastructures. He discussed the high-level design and key features of Borealis, a scalable distributed stream processing engine that facilitates low-latency processing of high-volume data streams. Borealis is a follow-up project to an early data stream management system developed at Brown called Aurora. He also gave an overview of XPORT, an adaptive profile-driven stream dissemination system. Both systems significantly ease the development and deployment of robust and efficient stream-based applications.

The day ended with a talk from Sam Madden from MIT. His topic was titled "Data Management for Next Generation Wireless Sensor Networks." He discussed some of the recent developments in data management for large networks of wireless sensor devices, focusing particularly on aspects of the work he is doing at MIT related to modeling and summarization of sensor network data, as well as new applications involving mobile devices collecting and transmitting data at high rates. His main premise is that there is great benefit to being able to write sensor-based applications in a declarative programming language like SQL.

> "In any modern enterprise, the rate at which data must be ingested and acted on intelligently is increasing rapidly."

Sam presented some results from a fascinating project called CarTel in which cars are outfitted with many sensors, a computer, and a wireless radio that can transmit information about the status of the car, the road, or the environment to a base station. One example that he cited was of cars with accelerometers driving through a city discovering potholes. Another was of cars mapping the city for open WiFi hotspots.

Summary

It was clear from the discussion that there is intense interest in this topic. Several of the attendees commented about how the day was germane to the kinds of problems that they are currently facing in their businesses. This kind of interaction is exactly what the IPP program at Brown was designed for.

We would like to thank IPP co-directors John Hughes and Michael Black, Eli Upfal, chair of the computer science department, and Laura Zurowski for making this program happen. Finally, the day would not have been possible without the generous contribution of our speakers. To them, we express our deepest thanks. C!

Industrial Partners Program

The primary goals of the Industrial Partners Program (IPP) are to exceed the expectations of our partner companies in terms of recruiting and outreach; to allow our faculty to engage in challenging and meaningful research collaborations; and to provide resources, funding and employment to our students.

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

Collaborators
Cisco Systems

Premier Partners
Adobe
Microsoft
Network Appliance
Sun Microsystems

Affiliates
ITA Software
Google
GTECH
VMware

Small Business Supporters
Linkage Systems

Individuals
Jim Baker, BizLogix
Paul Edelman, Edelman & Associates

For more information about the Industrial Partners Program, contact:

Michael Black, Faculty Co-Director
Telephone: (401) 863-7600
Michael_Black@brown.edu

John Hughes, Faculty Co-Director
Telephone: (401) 863-7600
John_Hughes@brown.edu

Laura Zurowski, Program Manager
Telephone: (401) 863-7610
Laura_Zurowski@brown.edu

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

Unplugged

Professor **Eugene Charniak**'s research is in the area of language understanding or technologies which relate to it, such as knowledge representation, reasoning under uncertainty, and learning.

The other day the editor-in-chief and I were saying that *Conduit* should move upscale. I was thinking that we needed more ads for expensive watches—like those on pages two and three of the NYT. Naturally, we also need more upscale content to attract the advertisers, like book and movie reviews, perhaps even a style section.

So I figure I will do a book review this time. Of course, I am going to continue with my rule that I never do research for this column, so the first problem is that I am not sure I remember the name of the book—I read it about a year ago. I think it is something like *Human Achievement*. I do remember the author, Charles Murray, but I am not sure I remember how he spells it. I think that's right. At any rate, he is one of the two authors of one of the most controversial books of the late 20th century—*The Bell Curve*. I would recommend both books. If you don't like what you have heard about the latter book (many consider it racist), just read the first two thirds: race is not mentioned at all, and the argument about the stratification of U.S. society is quite powerful.

ABOVE Eugene has decided to move upscale. We can't wait to read his future commentary on computer science "styles" (Bow ties making a comeback? You don't say!).

Human Achievement is a much quieter book. Murray starts out by trying to create, in a relatively culturally unbiased way, lists of the greatest accomplishments in art, science, and philosophy, and of the greatest artists, scientists, and philosophers who did them. That takes up the first three quarters of the book. In the last quarter he tries to correlate properties of societies with the accomplishments of those societies as reflected in the lists in the first portion.

The lists—there are ten of them—are fascinating. Each basic area of accomplishment has two lists: one for accomplishers, one for accomplishments. Eastern and Western art and philosophy are separated—Murray argues that here there are cultural divides that defy a "culture-neutral" approach. On the other hand, within, say, Western art, it is not necessary to get any more fine-grained. He does not find it necessary to split Eastern and Western science, and thus arrives at ten lists in all.

To create each list, Murray consults dictionaries of, say, science. He uses dictionaries created in a variety of countries in case there are local biases in favor of home-team scientists, though he reports (I think) less of this than one would imagine. He then counts column inches and reports, say, the twenty western artists with the highest totals.

I distinctly remember that I thought his twenty greatest western artist list was quite reasonable. It attempts to be, after all, a consensus view. He is not out to show how knowledgeable he is by picking people no one else has heard of. In particular, there was only one name on the list with which I was unfamiliar. Of course, I have forgotten it now, but at the time I went to my wife, who is also an art buff, and asked if she knew who this guy was. She gave me a look suggesting that her poor addled husband had finally reached the end of his warranty period and said that of course she did: he is the fellow who first perfected the art of perspective in the early Renaissance. She did grant that he might be less familiar because there were very few paintings that could be reliably traced back to him, and most of those are in Italy. So the list looks pretty solid.

As I said earlier, after creating these lists, Murray asks what features of societies lead to significant numbers of great achievers. Of course, with only this criterion, one answer would be societies with large populations. So it is necessary to ask about great achievers per unit population.

With one exception, the societal features that correlate with greatness are uncontroversial—free expression, lack of castes and other hindrances to personal freedom, enough wealth to support a creative elite, etc. The one controversial entry is Murray's conclusion that a society should have a firm foundation of religious belief. I gather that Murray himself was surprised by his conclusion, since (according to a book review I read) he is not a religious person.

This conclusion, however, is supported by only one data point. Murray stops his accomplishment lists at 1950, saying that after that things are too new to be judged. However, he contends that the period 1900-1950, while having a great number of great artists, scientists, etc., still scores low in count adjusted by population, and

that the only way to distinguish it from previous periods is by the factor of religious belief.

I find this conclusion very surprising as well, since I myself am not much of a religious person either (to put it mildly). There are also interesting results showing that, while modern U.S. scientists as a whole are as religious as the rest of the population, elite scientists (those in the National Academy of Sciences) are much less religious. So I believe there is something wrong with Murray's conclusion in this regard, but figuring out his error is not trivial.

"I was thinking that we needed more ads for expensive watches—like those on pages two and three of the NYT."

Two possible errors seem plausible to me. One is that the dictionaries of science, art, and the like prefer to list a uniform distribution of entries per unit time, thus over-representing earlier, less populous periods.* The other is that the categories of accomplishment are themselves biased. Suppose we ask which societies produced the greatest filmmakers. Needless to say, 1900-1950 would come out on top. Conversely, by not counting film, Murray is biasing his counts against that period. While Murray justifies his selection of categories, it is the weakest part of the book. I am exaggerating only slightly if I say that his justification in this instance boils down to "Well, film is not really an art". And, of course, film was not the only art form that got axed. I recently saw two episodes of a PBS series on the history of Broadway musicals. I came away realizing I had to change my opinion of this art form because (a) it IS an art form and (b) it probably deserves to be considered the opera of the 20th century. Murray would have none of this.

Lastly, just as the arts have flowered in many directions, so has science. While at one time all of science could be contained in one dictionary, now we have dictionaries upon dictionaries of specializations, often ones that have only recently been defined.

It is my belief that I have been lucky to live in one of the greatest societies of all time, and that all of the 20th century will be remembered for both great butchery and (no matter how you quantify it) huge accomplishments, Murray, to the contrary, notwithstanding. **C!**

*Trina Avery, in a near swan song at Brown (she retired on March 6), says, "This error seems implausible to me: so much less of the history of 'earlier, less populous' periods is known than of later periods that, try as one might, a uniform distribution could hardly be achieved."

Brown-Harvard-MIT Natural Language Processing (NLP) Workshop:

On March 13th, Brown's Laboratory for Linguistic Information Processing (BLLIP) hosted the first ever Brown-Harvard-MIT natural language processing (NLP) workshop. The idea for the workshop came when a Brown and MIT student met at an NLP conference the previous fall and discussed how the physical proximity of their schools provided a great opportunity for collaboration and mutual exchange of ideas that had been largely going untapped. A workshop bringing together the schools, they thought, could provide a venue for sharing and presenting research interests, goals, and ideas with one another to get feedback and forge new collaborations going forward.

As such, the workshop was entirely student organized and centered on all participating students making short presentations on their research and receiving feedback from the group. Faculty from the three schools also attended and participated in the discussions. Overall, the event was deemed by participants to be a solid first step in fostering a greater sense of NLP community between the three universities, and the groups look forward to continuing these workshops on a semi-annual basis. **C!**

ABOVE The workshop attendees gathered for a group photo before the discussions began. Eugene quickly agreed to sit front and center!

Parenthetically Speaking

Parenthetically Speaking is a new feature column by Associate Professor **Shriram Krishnamurthi**. A full list of his numerous book reviews can be found at www.cs.brown.edu/~sk/Personal Books/

ABOVE Shriram is also busy writing books of his own. The latest version of *Programming Languages: Application and Interpretation* is available through www.cs.brown.edu/people/sk/Publications/Books/ProgLangs/

I read. Never nearly enough, and perhaps too poorly, but I soldier on. I've learned, however, that my sieve of a brain forgets too much, too soon. As an exercise, I set myself the discipline of reviewing everything I write. It makes me a sharper reader and, more usefully, improves my later recall. I've been contributing these reviews to the flotsam of the Web for some years now; Laura's persuasion, bribery and flattery led to this column of excerpts.

This column's uninspired name is, of course, a weak inside joke for those who know me. But for those who don't, I can offer three other explanations. First, it's understated and deprecatory, which is fitting given that book reviewing is not a primary area of expertise for a computer science department. Second, it's vague enough to let me expand the column without being constricted by the title. And finally, my choice of a title completely devoid of fashion ensures it will never suffer going out of fashion, unlike some other regular columns in these pages that are ***so*** 1990s!

***The Bridge of San Luis Rey*, Thornton Wilder**
A stunning little gem. A priest examines the lives of five who died in the kind of freak accident that leaves rational people asking, "Why them?" Wilder takes on a controversial topic in what appears to have been a much less tolerant time (though the writing's timeless quality never gives away that it was written in 1927), only loosely disguising the question in a historical context. The rest is the kind of book you hope never ends, with turns of phrase so delectable you linger over single lines for whole minutes—yet Wilder never gives the impression he is showboating. The book begins in breath-taking fashion; the middle sections initially seem like a let-down, until the author's plan becomes clear; only the conclusion is disappointing, almost as if Wilder couldn't bring himself to let the real conclusion, in all its ambiguity, stand on its own.

***Henry Ford and the Jews*, Neil Baldwin**
Many of us have known, vaguely, that Henry Ford was a rather unpleasant little character, particularly in his views of Jews and World Orders. Baldwin, in a solid piece of reporting, lays out this case in extensive detail. He demonstrates how Ford created his own paper, the *Dearborn Independent*, as a mouthpiece for some of his most distasteful views; how he forced his car's dealers to compel newspaper subscriptions out of car purchasers; and how he led the publication and dissemination of *The Protocols of the Elders of Zion* in the US. Baldwin loosely touches on the questionable leanings of Ford's friends and fellow American icons, Edison and Lindbergh, though their stories are better documented elsewhere. The book gives the sense of being thoroughly researched and, while Baldwin has an obvious slant, he tries to make a fairly even-handed case, acquitting or tempering the case against Ford in some instances (especially in connection with the Nazis). One senses a writer who wants to brook no accusation of over-dramatization, thus strengthening his indictment of Ford.

Yet for all this, there's something mildly dissatisfying about Baldwin's account. It's hardly surprising that Ford, or indeed that a good number of his compatriots, held views we now find distasteful. The case I find Baldwin does not make is that this had any serious impact on the public. As the book clearly demonstrates, the *Dearborn Independent* never grew to be any kind of major publication, and its run lasted only a few years despite Ford's deep pockets. Ford eventually won the disapprobation of numerous editorial sources; even his company and family eventually strove to distance themselves from his views. At the very least, it seems Ford could have made matters much worse in the US—something he plainly failed to accomplish. Thank goodness.

***Travel Writing*, L. Peat O'Neil**
I'm not quite sure what impelled me to buy this book. Perhaps I was hoping to learn something about what makes great travel writers. Maybe in a fit of frenzy I contemplated quitting the day job. Who knows. What I did learn: if this is the quality of advice coming down from experts, it's no surprise that so much travel writing is so uniformly predictable and stagnant, and why newspaper and magazine travel sections are so often difficult to distinguish from the paid advertisements. Except, I don't think the author meant to convey any of these sentiments. **C!**

Tired of BOCA? Try Mocha!

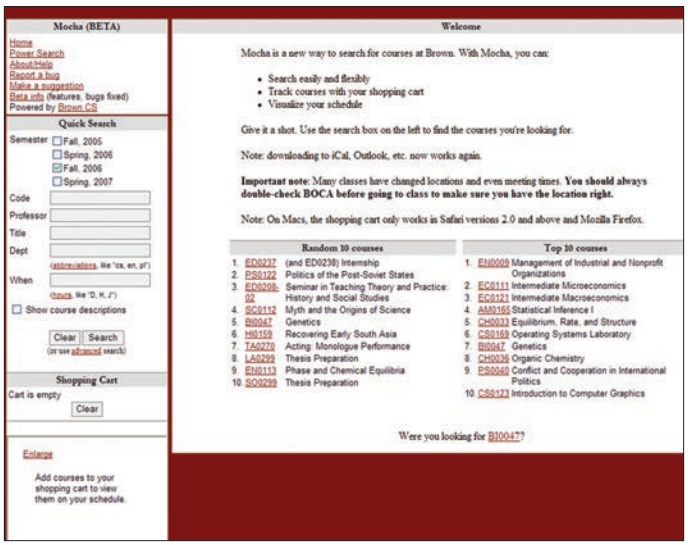
Brenna Carmody, Brown Daily Herald

In response to the frustration often generated by the Brown Online Course Announcement (BOCA), five computer science concentrators have created a user-friendly and more comprehensive version.

> "BOCA only allows one description to be searched at a time, while Mocha allows for "any kind of search you can think of," according to Dave Pacheco '07, one of the site's creators."

The new program, called Mocha, is not affiliated with the University or the Registrar's Office, but it is currently available to students on a Web site hosted by the Department of Computer Science's server. Some of Mocha's features include the ability to add courses to a shopping cart and to create a color-coordinated schedule. Students can also bookmark classes and enter class numbers without the number of zeroes required by BOCA. An additional benefit of the site is an enhanced search capability, according to the creators.

BOCA only allows one description to be searched at a time, while Mocha allows for "any kind of search you can think of," according to Dave Pacheco '07, one of the site's creators. BOCA is usually slow the night before classes start, he added, but with Mocha, the condensed searches reduce the load on the servers.



Mocha is the creation of five members of the class of 2007—Dave Pacheco, Daniel Leventhal, Adam Cath, Dave Hirshberg and Bill Pijewski—who came up with the idea for an alternative to BOCA last spring during CS32: "Introduction to Software Engineering." The scope of a final project for the class inspired them to redesign BOCA's interface. "Sometimes I was getting so frustrated with BOCA, so I wanted to make something a little more flexible," Pacheco said.

The creators claim their rationale for producing Mocha was selfish. "We mainly did it so we could not have to use BOCA," Pacheco said. However, they did consider the Brown community when designing it. "We made it useful to us and added things that could be useful to other people," Leventhal said.

Some students who have tried Mocha have reacted positively to the new interface. "I have enough other things to think about. It makes shopping period so much easier," said Annie Blazejack '09.

"It was fun to find a new program that cut the work in half for me," said Daniela Alvarado '08.

Jonathan Juarez '09 added that Mocha was "a dream come true for the disorganized."

The team plans to add features such as e-mail reminders about exams, exam times, compatibility with iCal—a calendar program created by Apple Computer, Inc.—and the ability to link schedules between users.

Visit http://mocha.cs.brown.edu for the Mocha experience. **C!**

Department News and Happenings

CS Department Combats RSI

Ph.D. candidate **Jenine Turner** is the department's ergonomics awareness coordinator. **Glencora Borradaile**, also a Ph.D. candidate, maintains a webpage of yoga postures to help alleviate RSI.

There appears to be a departmental epidemic of Repetitive Strain Injury, also known as RSI. We have been flagged by the hand surgery department of University Orthopedics as having an unusually high number of injuries for a computer science department. An informal survey of graduate students backs up this concern: 40% of total grad students in the department told us that they have some discomfort when typing, and 10% have more serious problems.

ABOVE Yoga instructor Naama Gidron of Iyengar Yoga Providence demonstrates a chair twist and a shoulder opener. Visit www.cs.brown.edu/facilities/ergo/yoga for pictures and descriptions of the poses she presented.

Despite these doom and gloom numbers, we are not without hope. Although we are behind other computer science departments that have addressed this issue beginning in the early 1990s, our department has recently devoted substantial resources to try to address this problem. The department's house committee arranged for the ergonomic furniture on the third floor. We have had three rounds of ergonomic inspections, resulting in fixes to ailing workstations. More people now have adjustable desks. In 2004, a departmental ergonomic equipment pool was created; faculty, grads, and staff can check keyboards and mice out for two weeks. We can thank the facilities committee for the equipment pool, and for the flat panels that replaced the regular monitors.

In addition to supplying the ergonomic equipment, awareness efforts have been stepped up. Typing break software has been on departmental machines for over five years now, and we have initiated an annual RSI talk. Dr. Weiss, a hand surgeon at Rhode Island Hospital, has been part of the effort to raise awareness and share health information. Andy van Dam was instrumental in getting these talks started, and he has been extremely supportive of our work. We also have posters, flyers and leaflets that we distribute, and we now give an ergonomic orientation to new graduate students. Last month, the department paid for a yoga instructor to spend an hour showing staff members different yoga stretches that can be done at a desk or in the office.

In January, the department began funding a graduate ergonomics merc position. I am that person. If you are injured, come talk to me and I'll walk you through the University ropes. Many of us have been through what you're going through and there is no need to reinvent the wheel.

What can you do to prevent injury? Get your workstation evaluated, or use OSHA's e-tool (www.osha.gov/SLTC/etools/computerworkstations/index.html). Make sure that you're taking plenty of breaks, particularly when working towards a deadline. Use Workrave, installed on the Linux and Windows machines, and listen to your body. If you're tired, get up and walk around. Don't type through pain. If you're using a laptop, use an external keyboard.

If you feel pain, stop typing. See a doctor and get some rest. All of the prevention tips listed above still apply. Visit our web site www.cs.brown.edu/facilities/ergo, and join our listserv. Finally, come see me and I'll make sure that you know what resources are available to you. **C!**

National Society of Black Engineers

The highlight of NSBE's year was the annual trip to the national convention in Pittsburgh, PA. Unfortunately, the convention coincided with our spring break so not as many people made the trip as we would have liked, but for those extra-committed members who did, the event turned out to be more successful than we expected.

Most years, we hope that half of our seniors will find jobs and a few underclassmen will get internships. This year, all of the seniors who traveled to Pittsburgh either have offers or promising opportunities. Additionally, one rising senior has two offers for summer internships, and a rising junior is seriously looking at a position within the Department of Energy.

Two students from the computer science department were able to attend the conference—Chipalo Street '06 and Emuye Taylor '06. Emuye wants to work for Apple, and after impressing them at their booth at the career fair, they invited her out to dinner with the recruiters! She is now preparing for a round of onsite interviews in California. Chipalo had already secured an internship with Microsoft, so he spent much of his time in various workshops and networking at the career fair.

Aside from the huge job fair, the convention also held over 40 workshops including: Financial Planning; Career Development and Management Success Factors; and Communicating Across Cultures. These workshops were presented by senior NSBE officials or members of companies represented in the job fair.

After a long day of interviews and workshops, there were great entertainment events. Every evening different companies sponsored hospitality suites complete with catered food and managers to network with. There was a gospel concert on Thursday, a comedy show on Friday, and Mos Def performed on Saturday.

The only down side to the convention was Sunday, checkout day. We had to be out of our rooms by 12:00 pm, but our flight didn't take off until 8:40 pm. This meant that our members got to know the Pittsburgh airport better than any traveler would like, but it's a small price to pay for a successful conference. **C!**

Peter Wegner Reflects on Trina Avery's Retirement from the Department

I first met Trina soon after joining the Brown Applied Mathematics department in the summer of 1969. She had left her job there in 1967 upon the arrival of her daughter Jessica, and during the 1970s helped me rewrite and edit numerous papers and books.

Upon the creation of the computer science department in 1979, I strongly urged Trina to apply for the job of department manager. In that capacity, she has played an important role in running the department for more than 25 years, receiving much praise from successive department chairs. She also helped to edit the manuscripts of several faculty members and spruced up numerous grant proposals and other departmental initiatives.

All told, the quality of our department and its financial growth has benefited greatly from Trina's substantial contributions, and many of us benefited individually from her input to our work. We are very sad to lose her, but we realize that all roles, no matter how important, must come to an end. We wish Trina great and enduring happiness in her retirement. **C!**

TOP The Brown University Faculty Club was crowded with well-wishers and old friends for Trina Avery's retirement party. Featured are Emeritus Professor Peter Wegner with Trina (left) and Trina with husband Tom Doeppner (right).
MIDDLE Several members of the department were honored with longevity awards at the January 2006 Brown Employees Awards and Recognition ceremony. Kathy Kirman (left) of TSTAFF was recognized for twenty-five years of service while Fran Palazzo of ASTAFF, and Lisa Manekofsky and Mark Oribello of GSTAFF were recognized for ten years of service.
BOTTOM (left) The spring semester brought Assistant Professor Chad Jenkins and Sc.M. student Brendan Dickinson to the San Miguel middle school in Providence for a robo-dog demonstration. Students and teachers agreed that the visit was one of the most interesting (and exciting) they have ever had. (right) When Eramithe Delva, co-founder of the Commission of Women Victims for Victims in Port-au-Prince, Haiti, received a donated laptop computer from the department last fall, it represented a milestone. Wrote Eramithe, "When we started our work, we had a lot of determination and vision but very few resources. Now we are able to computerize all of our case records, and our clinic can run much more efficiently."

SPOCs Speak Out

Blame it on Adam Stauffer

In December, Adam was an invited speaker at the IPP Symposium, "Managing the Fire Hose" hosted by Stan Zdonik. Ten minutes before his scheduled talk time he was nowhere to be found. A quick search found him at TSTAFF headquarters reminiscing about his SPOC (Systems Programmer, Operator, and Consultants) days. It's amazing what happens when a former SPOC returns to the nest—one by one Jeff Coady, John Bazik, Mark Dieterich, Max Salvas, Kathy Kirman and Dorinda Moulton all come out of their offices and the conversations begin. It was during Adam's visit that the idea to collect stories from other SPOCs was born. So, whether you're a SPOC who regularly keeps in touch, or not, we hope you'll enjoy this collection of memories. And if you'd like to add your own two cents, please do—we'll try our best to publish them in the next issue.

ABOVE Adam Stauffer '92 (left) with TSTAFFers Dorinda Mouton, John Bazik and Jeff Coady.

ABOVE The SPOC hall of fame is located in the machine room on the 5th floor.

Candace Batts '01

Candace.Batts@ars.usda.gov

I remember that we used to have tech staff meetings in Jeff Cody's office and we (Nick and I) would frequently leave "SPOC droppings" these were various items such as mugs, pens, etc. I just think that is the funniest term…Once we needed an extra port for a new SPOC machine, and so we unplugged one that we hadn't seen any activity on for a while. A few days later, we got an email from a grad student who couldn't figure out why his network connection just died. (Whoops!)

Mike Shapiro '96, '97 Sc.M.

mws@sun.com

Memories of a SPOC, 1994-1997: The first time I remember hearing about SPOCs was during the technical training for SunLab consultants. Two senior undergraduates showed up, were introduced as "the SPOCs" and gave us a bunch of information about various issues we might encounter and how to fix them. This didn't seem that out of the ordinary, until afterward one of the other consultants explained to us that these folks got their own office upstairs—awesome!— their own workstations—gasp!—(recall that this was 1993, and having your own SPARC station was roughly like saying you rode a hovercar to class), and the root password to every UNIX system in the CS department. This last item was truly beyond comprehension: like the name of God in Hebrew, the root password was spoken of, but could never actually be pronounced or take written form. And we all treated it as such, speaking of it only in whispered tones.

…It was while answering this question that I think I first truly considered the impact of the opportunity that was being offered, how remarkable it was that the department would entrust such responsibility to undergraduates, and the talented people who I would have a chance to work with and learn from. Twelve years later, my amazement at the privileges and responsibilities has only deepened as I see what a profound impact my experiences as SPOC and systems programmer from 1994 to 1997 had on my growth as a software engineer and as a person. And after nearly a decade in the computer industry, I also look back and think that the team on tstaff were some of the finest people I've worked with…

Mary Fernandez '88, '89 Sc.M.

mff@research.att.com

Adam L Buchsbaum '88

alb@research.att.com

Mary: From a historical perspective, we were SPOCs before laptops existed. So one of the biggest benefits was that SPOCs got their own desk, chair, and computer! No waiting in line for a computer or printer. I'm guessing that students don't have to wait for anything anymore... I also enjoy telling our kids that the jobs that daddy and I used to do are now done by robots. I'm sure they wouldn't mind replacing us with robots from time to time! But my favorite part of being a SPOC was the people. Dorinda, Jeff and Max treated us with so much respect and appreciation. It was a great job!

Adam: Funny stories: Did you know Mary and I played footsie under the table during all the staff meetings? As I remember, that went on for a few months before Bent walked in on us necking in the machine room, at which point we had to get married.

Pleasant memories: How Jeff freaked out when he learned how I shut off the cold water to the Lieberts to defrost the grills whenever the machine room started to overheat. And how I more or less daily over the summers rebooted Nancy remotely from New Jersey to unstick UUCP (there's

a blast from the past) so that Mary and I could get email to each other.

Impact on life: Well, isn't that obvious?

Dorothy (Faulstich!) Bowe '86
dot@bowe.us

When I think back to my year as a SPOC, two memories jump out. The first is doing the monthly level 0 backups. (Bet you don't do *that* anymore!) The first time during the summer wasn't too bad. I was subletting an apartment for the summer that was probably about 3/4 mile from CS. Being a runner, I simply rolled out of bed at 3 a.m., slipped on my running shoes and ran up Thayer Street to start the backups. By the time CS opened at 6am I was ready for a cup of coffee and a bagel, followed by a 9 a.m. nap!

The other story is only funny because it's behind me. I don't remember why, but I was changing something in Skylar's (or was it Skyler?) password file and executed a "rsh skylar mv/etc/passwd/etc/passwd.save" as root and a split second later realized that was a bad thing. I believe I went to twd (Tom Doeppner) and said something about "hypothetically speaking, what would happen if you renamed the password file?" He resolved the problem somehow without me getting in too much trouble.

Stephanie Schaaf '98
sas@alumni.brown.edu

One year when Mike Shapiro was system programmer, we all came to the CIT at 6 a.m.to upgrade the servers. Mike was heavily caffeinated and bouncing around like crazy. His first words to us were, "It's so early, I almost vomited in the shower." I remember him saying, "Everyone needs a screwdriver! Here's one for you and one for you and..." while handing them out. Good times! :)

Narayanan Ramachandran '00 Sc.M.
nars@kadamba.org

…it has been one of the best experiences in my life and it's certainly made a lasting impression on my career. I've made some amazing friends and I've been very sad to see Tom go away too.

TOP Dorinda's SPOC photo collection.

MIDDLE The other Spoc as drawn by SPOC Mike Galvin '89.

BOTTOM Being a SPOC can certainly assist your career but who thought it could also result in love and happiness? Adam Buchsbaum (left) and Mary Fernandez (right) with their family.

Dorinda Moulton, User Services Coordinator
djm@cs.brown.edu

I get very attached to many SPOCs. There are a few that I've kept in touch with for many years after they've left and like a mother hen I worry and wonder how they're doing. And, as is happening with my own kids now that they are adults, I'm just now learning about things that went on without my knowing—such as footsie under the table during meetings! In spite of the work we would pile on, they always found ways to have fun. When they used to work late hours doing backups I would occasionally hear stories about very loud music coming from the machine room or movies in the SunLab. Now that I've started I could go on and on and on…

Jeff Coady, Director, Computer Facilities
jwc@cs.brown.edu

When I was asked to write something about the SPOC program for inclusion in a *Conduit* article, I thought this would be a wonderful opportunity for some clever anecdotes relating humorous events, insightful system solutions, and amazing saves during high pressure circumstances.

I would relate instances where these people sacrificed far above and beyond the call of duty and performed at levels exceeding any and all reasonable expectations. I would describe close personal relationships that developed between these people and the staff, many that remain today. Then I realized that I couldn't do it. Even though I can recall many such instances, unless I could assure equal representation to all, I just couldn't do it. There is no body of people that my staff, current and over the years, is more indebted to, and grateful for, than the SPOCs. We have shared disasters and great successes with these people right from the Apollo Lab twenty-three years ago to the current environment.

I think I can speak for every TSTAFF member (and a large number of faculty, students and alums) when I say THANK YOU, and we enjoyed working with all of you. **C!**

True Tales from the Tech World: CS Alums Tell-All!

Adam Leventhal joined the Solaris Kernel group after graduating from Brown in 2001 with a degree in Math-Computer Science. He can be reached at Adam.Leventhal@sun.com

Adventures with DTrace and BrandZ

Adam Leventhal is a Solaris Kernel Engineer at Sun Microsystems, Inc. He is one of the three authors of DTrace (the dynamic tracing facility new in Solaris 10), and is chiefly responsible for the user-level tracing components. In recognition of his work on DTrace, Adam has received Sun's chairman's award for technical excellence, and was named one of InfoWorld's Innovators of 2005. When he's not working on new features for DTrace, Adam has developed new observability tools for Solaris and spends a large amount of time applying those tools to bugs and performance problems.

ABOVE Adam was recently named one of InfoWorld's Innovators for 2005.

Adam visited the computer science department last fall to give a technical talk to students and to share his OpenSolaris experience.

"I was explaining some of the cool features in OpenSolaris with a bunch of demonstrations. When I demonstrated BrandZ running Linux inside of a zone, the students and faculty in attendance were very excited. When I demonstrated using DTrace to examine Linux processes, their jaws hit the floor. After the talk, I kept bumping into students in the hallways who were talking about how cool it was to see Linux applications running inside of Solaris, how it might be used, how it was implemented, etc. Some of them even went to OpenSolaris.org, downloaded the BrandZ bits, and got involved with the community. It was the type of interaction that wouldn't have been possible before OpenSolaris and really proved to me how open sourcing Solaris was making it interesting to students once again." **C!**

Peter H. Jakes graduated from Brown in 1968. He can be contacted at peter.jakes@verizon.net.

1968

I should explain that I suspect I was not at all typical of Andy van Dam's other students. In 1967-68, I took his Applied Math 101-102 course, and at the time, I think I was the only international relations major to do so. Had this not been my senior year, and had I not already set my sights in the direction of law school, I suspect that I would have taken a lot more courses with Andy, because I certainly got thoroughly hooked. I managed to pay for part of my law school tuition with two summer jobs: one at IBM in the summer of 1968, programming on IBM 360 computers in what was then considered to be an "advanced" programming language called "PL1" and the following summer I was at the Brookings Institution, where I joined Lance Salter and several other Brown alumni in writing an "English language like" compiler for doing research on census statistics called the Generalized Retrieval And Statistical System—acronym GRASS. (It was, after all, the late 60s). Following that, my career turned decidedly more in the direction of "the law", and after graduating from Yale Law School in 1971, I joined Willkie Farr & Gallagher here in New York, where I have been ever since.

But almost from the start, I kept complaining that lawyers were 19th century animals and needed to utilize computers in more creative ways. After hearing many complaints for several years, my firm took a classic lawyerly path: they formed a committee and put me on it. And I have now been chairman of that technology committee for longer than anyone can remember. All of which is to say, you never know what avd training will do for you! **C!**

Greetings from Chapel Hill

I am currently living southward, plugging away in the doctoral program in city and regional planning at the University of North Carolina at Chapel Hill. My coursework has drawn me away from computer science and into the world of ecology, of all things, but I still use much of what I learned at Brown in my research work. My dissertation will be a combination of two computer simulations: one modeling land use change in Charlotte, NC, and one modeling the hydrology of the Catawba/Yadkin River basin. The purpose of linking these models is to explore the relationship between land use patterns and water quality. All those hours of programming experience and systems thinking will hopefully pay off as I develop this software. I never thought I would use my CS32 skills to investigate the spatial distribution of fecal coliform, but there you have it.

My dissertation isn't much more than a twinkle in my eye and an NSF application right now, however. The teaching skills I gained as a TA with Spike, Pascal, and Manos are more immediately useful, as I am teaching my own under-

graduate course this semester for the first time. I have 24 students for "Solving Urban Problems." And to think I thought CS31 had us cover too much material! When I'm not trying to convince undergraduates that urban planning is real, I daydream about my other foray into the world outside computer science, my upcoming wedding to history major Josh Loh '03. We are getting married this August in Washington, DC. The picture is from our recent vacation to Ocracoke Island, NC. **C!**

From There to Here

I finally finished my Ph.D. in 2002, after a mere ten years at Brown, and immediately moved to the San Francisco bay area eager to put my research to work at the virtual world startup, There, Inc. As it turned out, however, late in their beta cycle, they were more in need of bug fixers than researchers, so, after just a few months, I left, rather soured on the industry coding experience.

Also in 2002, I had the great fortune to meet my wife, Gigi Lee. She was born in Shanghai, China, earned a graduate degree at Stanford, and is now a software engineer at Oracle. We were married in August, 2004 and live in Fremont, CA. This January we had our first child, a boy named Trevor, and since then, sleep has been a fond memory of the past.

Throughout my time at Brown, during every vacation I took back home, I worked with my father on developing algorithmic models for analyzing the stock market, back-testing different trading strategies over past market data in a crude form of combinatorial optimization. After my experience at There, I was eager to be my own boss, so in 2005, Gigi and I opened Dollins Investment Advisors, LLC, managing stock investment portfolios for individuals. We already have a few Brown alumni among our clients and are always looking for more. Check us out at http://www.DollinsInvesting.com/.

Although I'm no longer working in the computer graphics industry, I'm still putting the research and software development skills I learned at Brown to use by writing trading simulations and graphical data visualization tools for managing our clients' money. And I still use math to make the occasional pretty picture. **C!**

Tracy Hadden received a Sc.B. in Applied Math-Computer Science in 2004. She would love to hear from folks and can be found at tr@cs.brown.edu.

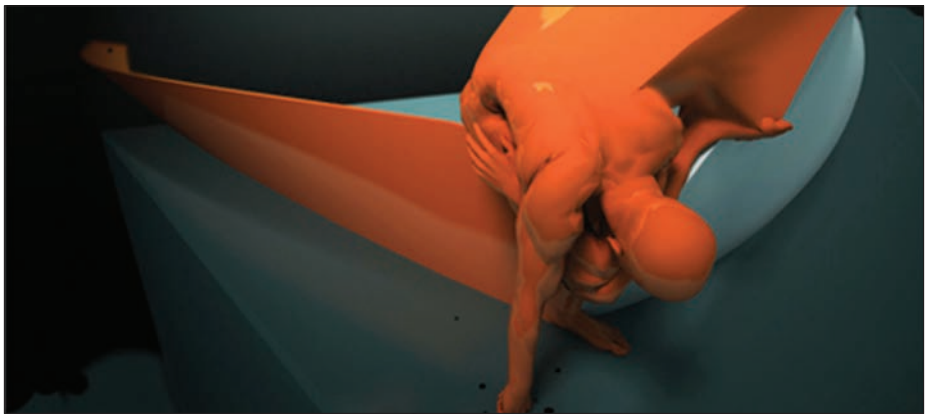
C! Comments?

Send your views to: Conduit,
Department of Computer Science,
Brown University, Box 1910,
Providence, RI 02912
or email conduit@cs.brown.edu

Steve Dollins received a Ph.D. in 2002. He can be found at scd@cs.brown.edu or through www.DollinsInvesting.com.

LEFT Tracy Hadden '04 (right) never guessed that she'd be using her CS32 skills to investigate the spatial distribution of fecal coliform!

RIGHT Matt Chotin '99 and David Wadhwani '93 of Adobe with Professor Michael Black. Adobe recently became a member of the department's Industrial Partners Program (IPP).



ABOVE Chris Elam '98 is the choreographer and artistic director of NYC-based Misnomer Dance Theater, a modern dance company. Elam is partnering with Vivian Rosenthal '98 and Jesse Seppi of Tronic Studio (tronicstudio.com) to create a motion-capture movement sequence for Res, a prominent digital film festival and magazine. Apple Computers is documenting the project and will launch the footage on their website this spring. To learn more visit misnomer.org.

True Tales from the Tech World: CS Alums Tell-All!

Jennifer Don Apy graduated in 1987. Jennifer and husband Don (also from the class of 1987), can be found at Jenapy@comcast.net and donapy@comcast.net.

ABOVE It's A Family Affair! Jennifer Don Apy '87, Donald Apy '87 and their two newest babies: 2½ week old Christopher, and 3 month old LearningTree Games (www.learningtreegames.com).

LearningTree Games

When we found out we were pregnant with an unexpected third child, I knew I needed more flexibility in my life, to keep a bright second grader on task, to meet the emotional needs of a sensitive preschooler, to be a creative partner to an at-home husband desiring intellectual focus (Donald Apy '87, A.B. Computer Science and Urban Studies), and a demanding job as a marketing executive for an educational toy company. Not to mention that no matter how much sleep I got, I was sick and exhausted morning, noon and night. So I did what any person in my situation probably should not do—I left a well-paying six-figure salary job for the negative cash flow (at least initially) life of an entrepreneur.

My path up to this point has always drawn upon my undergraduate fields of study (computer science and cognitive science), and my professional training as a marketer and information systems consultant. After graduating from Brown, I initially worked my way through the systems consulting ranks at Andersen Consulting (now known as Accenture), then earned an MBA at Stanford to ease the transition into consumer marketing. From our days as TAs for CS11 and CS1, Donald and I have always enjoyed teaching and supporting the goals of education, and the opportunity to create and promote children's educational products was appealing. I was lucky enough to initially land a job that eventually evolved into the position of brand manager for "Where in the World is Carmen Sandiego?" geography software games and licensed products. I never dreamed when I was in Andy's educational software seminar that I would later participate in the emergence of educational software as a mainstream consumer product category, and that learning games would go beyond Papert's LOGO to become more like interactive animated movies. Although my career path may seem to have strayed from my undergraduate training, the emergence of the internet as a viable marketing medium has made understanding computer applications and databases essential to adapting traditional marketing strategies in the new world of internet advertising and e-commerce.

Donald had worked in product engineering, IT, and enterprise systems development for over 15 years (the last 11 years at Sun Microsystems) and was eager to further explore e-commerce and web development. With his software development background and my experience with educational toys and child development, it was a natural move for us to start an educational toy retail website (www.learningtreegames.com). Through my previous jobs, I know how hard it is for products with solid educational value to break through the clutter on store shelves. We wanted to make it easy for parents to search through selections of truly educational and innovative toys, using tools to easily tailor a search to a child's interests, skills, or occasion. We were able to launch a basic site for the 2005 holiday season, with child development articles to help parents understand how toys build essential skills, and are currently developing more robust search tools and new, unique product lines for 2006. As we grow the company, our computer science training will play into the development of new online tools designed to individualize the search process, tailoring the selection even further to match children's skill levels. Our goal is to make the site a valuable resource for parents and families who care about their children's futures.

It has been hard work and a lot of sweat equity, but we've approached breakeven on our out-of-pocket costs within just a few months of operation. We each wear multiple hats—I may do a radio interview at 5 a.m., customer service and vendor calls in the morning and product development in the afternoon. Donald may work all night on the website, then ship orders in the afternoon until he picks the kids up from school. Both of us enjoy playing with our kids and testing new toys and games. Andrew and Marissa, our 7 and 3 year olds, are natural product testers, and our house is a great big market research lab! We work around the clock, seven days a week, as we work around our time with our kids. Yes, we still occasionally pull all-nighters, however it takes MUCH longer to recover than it did when we were undergrads.

While we're not blazing the way for computing technology, we are applying our training and ex-

perience to further the promise of e-commerce. We enjoy working together, as we did in CS224 when we rendered a candle flame for Andy's CS224 computer graphics course (I don't think the HPs we used then ever finished rendering our project after three days of processing, but the thinking was there!). Inspired by the dedication of professors like Andy and John Savage, and the camaraderie-filled CS team teaching assistant experience (where working closely with students and professors helped us gain greater insights into the course material), we continue to teach and learn through our teaching—whether it is Sunday school, Junior Achievement classes, volunteer music instruction in elementary schools or playing with our kids. Our Brown educations, and specifically our CS training, have benefited us immensely, and we fondly remember our days in the Apollo lab. **C!**

Revolution in the Valley

The Andy Hertzfeld '75 visited the department in mid-March to discuss his recent book, *Revolution in the Valley*, (O'Reilly, 2004).

ABOVE Dan Bornstein '92 (left) and Andy Hertzfeld '75 (right) of Google talk with students during a recent visit.

Andy was an early Apple employee and one of the main designers of Apple's original Macintosh computer, writing the initial operating system and user interface toolbox. He left Apple in 1984 and went on to co-found three companies, Radius (1986), General Magic (1990) and Eazel (1999). He has been a software engineer at Google since August 2005.

In 2003, he created a website for collective storytelling called Folklore.org, focusing on stories about developing the Macintosh. The website led to the writing of *Revolution* which contains numerous anecdotes about the development of Apple's breakthrough product. His talk at Brown recounted lots of interesting stories that didn't make it into the book, from the early pre-Macintosh days at Apple Computer through the long evolution of the Macintosh to the present day. **C!**

ABOVE Scott Snibbe's interactive video installation, *Deep Walls,* opened in the lobby of the CIT on February 27. Scott (left), who graduated in 1991 with an A.B. in computer science and visual arts, worked for the graphics group and received an Sc.M. in computer science in 1995. The exhibit and opening night reception were organized by Roberto Simanowski of German Studies, Edrex Fontanilla of CIS and Tom Doeppner (right) of computer science. Scott's work can be viewed online at: http://snibbe.com/.

In Memory of Bill Etienne '96 Ph.D.

William Joseph Etienne, age 39, of Newark, Delaware died suddenly in his sleep while vacationing in Watertown, NY on July 31, 2005. William grew up in Newark, and computers were a part of his life since his days at Newark's Central Middle School, where he taught himself during study hall to use an old TRS-80 found in the school's storage closet. After attending Salesianum School, he was one of the first African-Americans to graduate with a computer science major from the University of Delaware. He received his master's degree from California State University, Chico, and then spent three years in the Brown University computer science doctoral program before being lured away by Lotus Development Corporation. In 2000, he joined Idealab as a lead architect and help found several successful companies including Compete, Inc and Picasa. Most recently, he began the pursuit of his dream to establish his own software development business, AdLarge, pioneering the next generation of mobile telephone marketing services. Those wishing to honor Bill's memory may do so by contributing to the William J. Etienne Scholarship Fund at the Salesianum School, 1801 N. Broom Street, Wilmington, DE 19802.

Information provided by Martin-James Porter, Advancement Research **C!**

Computer Science Fundraising Initiative

Support Computer Science

If you would like to contribute to the Computer Science Department's fundraising initiative, please visit http://www.gifts.brown.edu/ or contact:

Mr. Ralph Scala
Office of University Advancement
Brown University, Box 1893
Providence, RI 02912 USA
Telephone: 401.863.9833
Email: Ralph_Scala@brown.edu.

The Computer Science Department is embarking on an ambitious fundraising campaign that is an integral part of the university-wide Plan for Academic Enrichment. This comprehensive computer science initiative has two overarching goals:

- Supporting excellence in teaching, research, and scholarship through expanded opportunities for Brown's faculty and students.
- Renovating the Thomas J. Watson Sr. Center for Information Technology.

A Commitment to Excellence

In order to maintain Brown's excellence in Computer Science, the department seeks two endowed professorships with which it can reward outstanding senior faculty members and attract distinguished teacher-researchers to the University. To date, Computer Science has secured one endowed chair, generously funded by friends of Professor Andy van Dam.

The department also aims to increase the number of postdoctoral positions, the number of graduate students, and its available resources so that it can continue and expand its cutting-edge work in a variety of areas. Graduate students are involved not only in the department's research and teaching activities, but also in helping chart its course. They serve on several important committees and help organize seminars and lunches as well as recruiting and orientation events. Their experience and curiosity bring invigoration to the department and create another level of support for undergraduates.

In addition to faculty work and graduate student training, Brown's Computer Science Department also places equal emphasis on maintaining the quality of its highly ranked undergraduate programs. Members of the department understand that a top-notch faculty and exciting learning opportunities will attract the most promising undergraduate students to the computer science program.

Renovating the Thomas J. Watson Sr. Center for Information Technology

When it opened in 1988, the award-winning Watson Center for Information Technology housed both the Computer Science Department and Brown's Computer Information Services. In 2004, the University moved Computer Information Services to another location and dedicated the full space in the Watson Center to the Computer Science Department. The space has been redesigned to accommodate multidisciplinary research groups and students in related concentrations who must collaborate on projects.

The renovation, estimated at a total cost of $2.5 million, enhances every aspect of computer science education at Brown. It opens space on the 3rd, 4th, and 5th floors for modern technology and classrooms. Specifically, the renovation includes a state-of-the-art motion-capture laboratory, an algorithms laboratory, an Internet laboratory, and two systems laboratories.

The work also creates modern, integrated office space for new faculty, staff, graduate students, and undergraduate teaching assistants. In keeping with the notion of a community of collaboration, the faculty, staff, and student offices are now intermixed and open onto lounges and meeting areas. The meeting and study space in the building has also been expanded to promote faculty and student interaction. The redesigned space contains group working areas, comfortable chairs, large tables, and whiteboards for idea sharing. Refurbished conference space for symposia and graduate and undergraduate functions also contribute to increased collegiality.

A gift to the Computer Science Department's fundraising initiative will directly benefit the faculty members and students who drive the ongoing, innovative work in this discipline. Support for this priority also goes straight to the heart of Brown University's overall mission—to foster the intellectual and personal growth of our students and to collaborate on solutions to problems that affect our neighborhoods, our nation, and the world. **C!**

Alumni Happenings

Reunion 2006

Be sure to save Saturday, May 27th for the 2nd annual Computer Science Reunion and Networking Reception.

Join computer science alums, faculty and friends from 5-7 p.m. on Saturday, May 27th. Enjoy a live jazz band, delicious hors d'oeuvres and beverages, and engaging conversation while touring the beautifully redesigned CIT 3rd and 4th floors. Last year's event was an enormous success, so be sure to include us as part of your commencement and reunion plans!

This reception is open to all CS alums, supporters and friends. If you plan on attending, please RSVP no later than May 15th at our website, www.cs.brown.edu/events/reunion/, or by calling 401.863.7600.

Alumni discussion and networking groups

Join the CS discussion groups and stay in touch with each other and the department. "Lubrano" is a moderated e-mail announcement list promoting employment opportunities, professional development and continuing education offerings. To learn more and subscribe, visit: http://groups.yahoo.com/group/cslubrano/

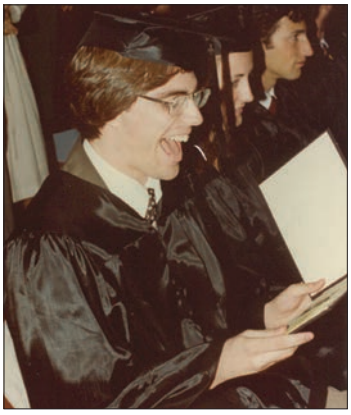
"CS Atrium" is an unmoderated networking and discussion forum promoting professional and personal communication among alumni. Conversation is not limited to technical matters! To learn more and subscribe, visit: http://groups.yahoo.com/group/CSAtrium/

Conduit wants your stories!

If you enjoy reading *Conduit*, you'll have even more fun writing for *Conduit*! Your stories, research, news and photographs are always appreciated. If you have ideas, suggestions, or would like to contribute, please contact Laura Zurowski at conduit@cs.brown.edu.








Hairstyles and eyeglass frames may have changed a bit since the early 1980s (when these photos were taken), but the excitement and celebration surrounding commencement remains the same. We hope that you'll attend the Computer Science Reunion and Networking Reception as a part of your commencement weekend plans. See you in May!

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.

First Name

Last Name

Class Year

Address

City

State

Zip

E-Mail

My news:

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

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