

TwitterHealth: Modeling Spread of Disease from Online Social Media

Adam Sadilek, Henry Kautz, and Vincent Silenzio

Given that five of your friends have flu-like symptoms, and that you have recently met eight people, possibly strangers, who complained about having runny noses and headaches, what is the probability that you will soon become ill as well? How are you going to feel a week from now? While questions of this type are ubiquitous, existing methods fail to answer them satisfactorily. Methods developed by Adam Sadilek and Henry Kautz (Department of Computer Science) in collaboration with Vincent Silenzio (School of Medicine and Dentistry) enable us to accurately quantify answers to such questions across a large sample of people participating in online social media.

Research in computational epidemiology to date has concentrated on coarse-grained statistical analysis of populations and simulated scenarios of disease outbreaks. Detailed studies have been limited to small domains, as scaling the methods involved poses considerable challenges. Furthermore, the state of the art of public health monitoring still relies on surveys and aggregate statistics obtained from healthcare providers. Such methods are costly, labor-intensive, and the data is often out of date.

By contrast, we focus on fine-grained modeling of the spread of infectious diseases throughout a large real-world population in real time. Our machine learning tech-

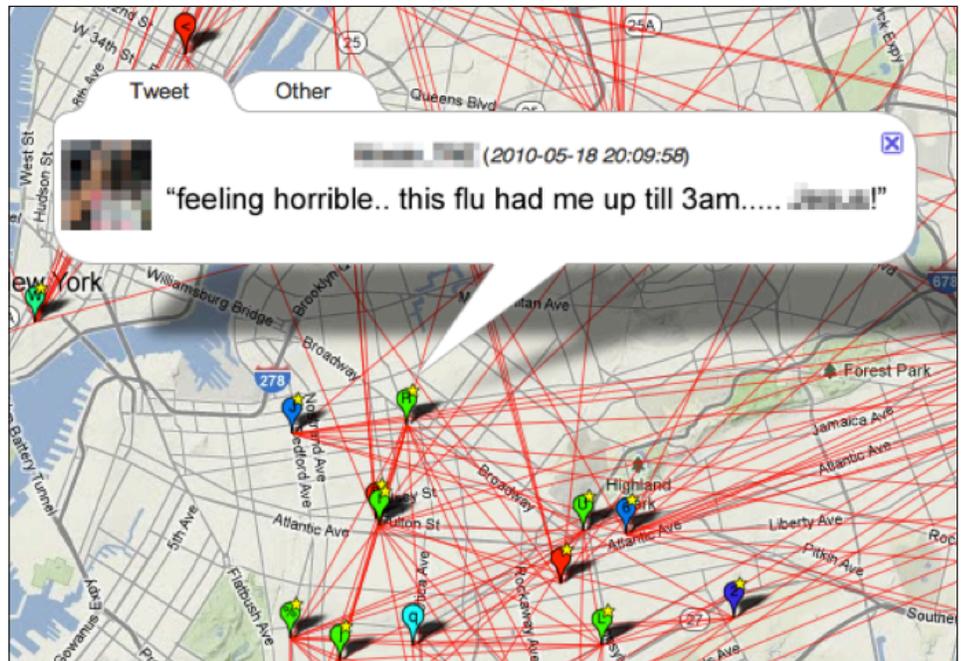


Figure 1. Visualization of a sample of friends in New York City. The red links between users represent friendships, and the colored pins show their current locations. We see the highlighted user complaining about her health and hinting at the specifics of her ailment. Our work investigates to what extent can we predict the day-to-day health of individuals.

niques reliably identify infected, symptomatic individuals based on the content of their communication in online social media.

Our experiments are based on data obtained from Twitter, a popular online social network where people post short message updates (a.k.a., "tweets") that are often geo-tagged. Twitter users form relationships between one another. We collected a sample of 2.5 million public GPS-tagged tweets from the New York City metropolitan area.

Statistical analysis of the data shows that avoiding encounters with infected people generally decreases your chances of becoming ill, whereas a large amount of contact with them makes onset of a disease almost certain. We find an exponential relationship between the intensity of collocation and the probability of contracting the illness in the near future. We then show that these signals can be leveraged in a probabilistic model that predicts if and when an individual will fall ill with consistently high accuracy for as far as eight days into the future.

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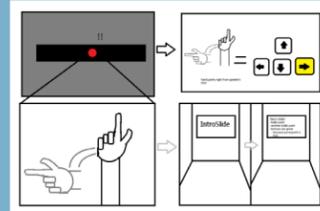
STUDENTS TAKE CONTROL WITH PERSVASIVE COMPUTING

By Henry Kautz



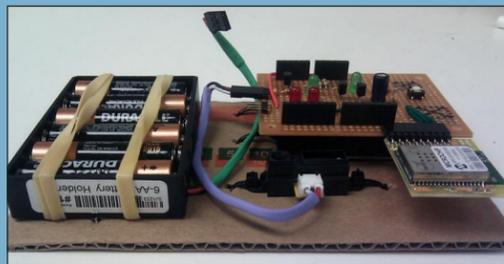
Our daily lives are enmeshed with computational devices. There are computers in our cell phones, wristwatches, games, televisions, appliances, automobiles, security systems, heating and cooling systems—the list expands every day, from the frivolous to the profound. The rise of the pervasive computing environment has engendered a community of people exploring novel alternative uses for these technologies. Such people were at first called “hackers,” but in recent years the community has adopted the more benevolent moniker “Makers.” The Makers’ creed is that technology and its impact on society is too important to be left in the control of corporations and governments. Making demystifies high tech and turns us from passive consumers to active participants in shaping our world.

In fall 2011, we offered a new Makers’ course, CSC 297 Pervasive Computing. Rather than listening to traditional lectures, the 17 students took control by *researching* the programming and hardware interfaces of various pervasive computing platforms, including Arduino, iRobot (Roomba), Parrot Drone Quadcopter, Neurosky Mindwave, Microsoft Kinect, and many others; *brainstorming* concepts and business cases for novel pervasive computing devices and services; and *implementing* a working system from storyboards through final prototype.



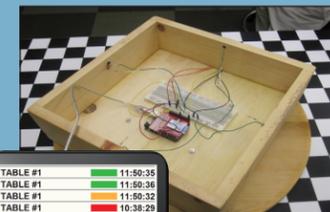
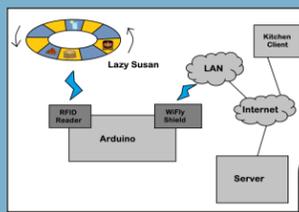
Storyboards from Kinect-ed Classroom. This interface allows a presentation program such as PowerPoint to be controlled by hand gestures. The system implements a virtual keyboard driver so that it can be easily configured to control any program.

Project by David Klein, Sam Atlas, Micah Fujiwara, Jason He, and Julian Herwitz.



Mail Buddy hardware. It can be inconvenient to check whether your mailbox has mail, particularly for students whose mailboxes are located in a building far from their dormitories. Mail Buddy solves the problem by sending an email to you when you receive mail. It takes the form of a slender, envelope-sized device that the user leaves in his or her mailbox. A rangefinder can detect the presence of mail in the mailbox and then connect to the University’s wi-fi network and send an email alert. A design that carefully manages power allows Mail Buddy to run for months between battery changes.

Project by Sam White, Anna Loparev, Eddie Samuels, and Kyle Murray.



Block diagram, inside view, and kitchen interface of RFID Menu. This system provides a fun and easy way to order food at a restaurant. Patrons place miniature models of the food items they wish to order onto a lazy susan and give it a spin. RFID tags on the models are read, the order is constructed, and then sent to a web interface in the kitchen.

Project by Gabe Unger, Harry Ledley, and Simon Weber.

TwitterHealth (con’t. from front page)

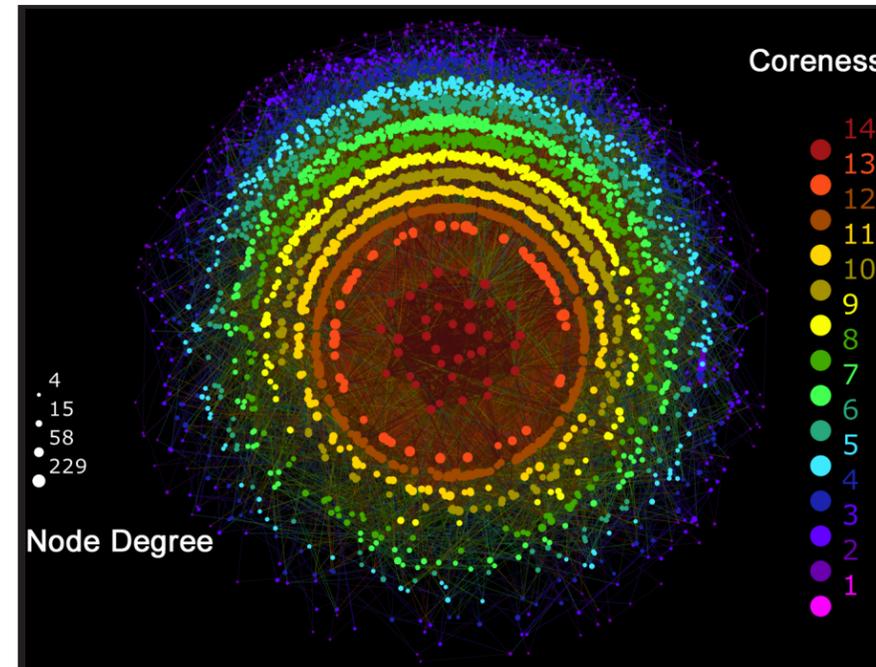


Figure 2

Figure 2. Visualization of the social network consisting of the geo-active users. Edges between nodes represent friendships on Twitter. We see that there are relatively few important “hubs” in the central area and a large number of less-connected individuals on the fringes.

To quantify the effect of social ties on disease transmission, we leverage users’ Twitter friendships (Figure 2). Each additional social tie to an infected individual significantly increases your chances of becoming ill in the near future. However, we do not believe that the social ties themselves cause or even facilitate the spread of an infection. Instead, the Twitter friendships are proxies and indicators for a complex set of phenomena that may not be directly accessible. For example, friends often eat out together, share items, and travel together. While most of these events are never explicitly mentioned online, they are crucial from the disease transmission perspective.

However, their likelihood is modulated by the structure of the social ties, allowing us to reason about contagion.

The results build a foundation for research on fundamental questions of public health, including the identification of non-cooperative disease carriers (“Typhoid Marys”) and adaptive vaccination policies. Furthermore, we provide the first quantifiable estimates of the characteristics and predictability of disease transmission on a population scale without active user participation—a step toward understanding the emergence of global epidemics from day-to-day interpersonal interactions.

To explore the health of Twitter users yourself, log on to <http://health.scenedipity.com> (developed with Andrew Abumoussa, Sean Brennan, and Martin Janda).

This article is based on the following academic publications:

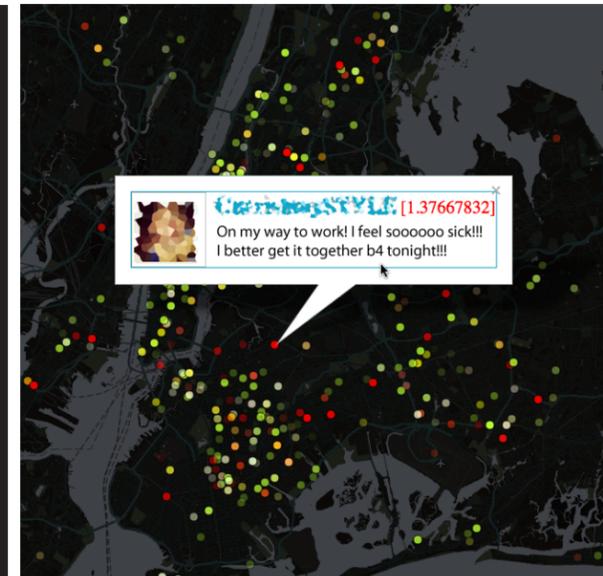


Figure 3

1. Adam Sadilek, Henry Kautz, and Vincent Silenzio. “Predicting Disease Transmission from Geo-Tagged Micro-Blog Data.” Twenty-Sixth AAAI Conference on Artificial Intelligence, 2012.

Honorable Mention

2. Adam Sadilek, Henry Kautz, and Vincent Silenzio. “Modeling Spread of Disease from Social Interactions.” Sixth AAAI International Conference on Weblogs and Social Media (ICWSM), 2012.

Best Paper Candidate

3. Adam Sadilek, Henry Kautz, and Jeffrey P. Bigham. “Finding Your Friends and Following Them to Where You Are.” Fifth ACM International Conference on Web Search and Data Mining (WSDM), 2012.

Best Paper Award

TRANSACTIONAL MEMORY COMES OF AGE

By Michael L. Scott



Twenty years in the making, transactional memory (TM) seems poised to become ubiquitous this year, and Rochester has played a major role in bringing it to fruition. Sometimes good ideas take time.

For the authors of parallel programs, *atomicity* is a key concern: how do we make a complex operation appear to occur “all at once” from the perspective of every other thread? Since the 1960s, the answer has been “use locks,” but lock management has proven a major source of correctness and performance bugs.

In 1993, Maurice Herlihy and Eliot Moss, then at DEC’s Cambridge Research Lab and UMass–Amherst, respectively, proposed to simplify atomicity by combining two key ideas: first, allow programmers to specify *what* should be made atomic without requiring them to specify *how* (i.e., without identifying locks); second, use *speculation* in the underlying system to execute to-be-atomic blocks of code in parallel, backing out and retrying if blocks interfered with one another. This combination had been used for disk-based database transactions for many years; what Herlihy and Moss proposed was to adapt the idea to much smaller operations on memory, and to support it with special hardware.

Unfortunately, this “transactional memory” (TM) proposal seemed too complex for the hardware of the day and was largely ignored for a decade. Several researchers—notably Nir Shavit and Dan Touitou of Tel Aviv University—suggested that a similar approach might be possible in software, but this work, too, was largely ignored outside the theory community.

All that changed a decade ago, when the prospect of multicore processors sent researchers scrambling for better synchronization

techniques. Work heated up on both the hardware and software fronts at labs around the world—and nowhere more intensely than at Rochester.

Since 2003, the URCS synchronization group has published some 50 papers on transactional memory, spanning formal semantics, software runtimes, hardware support, and hardware/software hybrids. Five PhD students have completed TM theses, and more are in the works. Michael Scott chaired the second ACM Workshop on TM in 2007; Rochester alumni Maged Michael and Mike Spear chaired the third (2008) and seventh (2012), respectively. The Rochester Software Transactional Memory (RSTM) package, comprising some two dozen different software TM runtimes, has been downloaded to thousands of sites around the world. The first of two hardware TM patents was awarded to Arrvinth Shriraman, Sandhya Dwarkadas, Virendra Marathe, and Michael Scott in May 2012.

In April 2012, 50 leading researchers in concurrency met in Dagstuhl, Germany, to assess the state of the field. Michael Scott and Sandhya Dwarkadas attended, as did Mike Spear and Maged Michael. Michael Scott was chosen to co-organize the follow-up meeting two years hence. In recognition of the lasting impact of their work, Herlihy, Moss, Shavit, and Touitou were awarded this year’s prestigious Dijkstra Prize in Distributed Computing. Scott was among the nominators and contributed much of the wording for the award citation.

The sense of excitement at Dagstuhl was palpable. STM compilers are now available from Intel, Oracle, TU Dresden, IBM, and Gnu. IBM’s Blue Gene/Q supercomputer has become the first commercially available machine with full-fledged TM hardware, and Intel has announced that hardware TM will be a standard feature of all its future x86 processors, beginning with the forthcoming “Haswell” chip.

Meanwhile, work at Rochester continues. The University took delivery of one of the first academic BG/Q machines in June. URCS PhD student Kyle Liddell served an internship with the BG/Q group at IBM last summer; student Lingxiang Xiang and postdoc Patrick Marlier are working there this summer; and student Ryan Yates is working this summer with the Intel group. It may have taken 20 years, but TM looks like it’s here to stay.

ROC HCI: ACCESSIBILITY, MOBILE DEVICES AND THE CROWD

By Jeffrey Bigham

The Human-Computer Interaction group at the University of Rochester (known as ROC HCI) is now three years old, and we’re having impact in research, education, and practice across campus. With computing technology nearly ubiquitous in our everyday lives, people in a number of disciplines are realizing that understanding the people using the technology we create is vital for real impact. HCI provides a framework for understanding users, designing technology likely to be useful, and evaluating when you’ve succeeded.

A research focus of ROC HCI is on intelligent user interfaces and human computation with emphasis on applications for people with disabilities. One of our projects made the leap from research to release last year. VizWiz is an iPhone application that lets blind people take a picture, speak a question about the picture, and receive an answer back from someone out on the web in just a few seconds. As research, we used it to introduce the notion of “real-time human computation”—and it won the Best Paper Award at UIST 2010. In 2011, we released VizWiz on the Apple App Store, and, over that time, about 5,000 people (most of whom are blind) have used it to ask more than 50,000 questions. It’s been fascinating to see the diversity of questions that people ask—from simple product identification and colors to watching the sunset and deciphering pregnancy tests.

While VizWiz explores the potential of getting quick answers from people out on the web (the crowd), our research this year has been on a new model of human computation in which the crowd works together on a task over a longer time. This fall we’ll be presenting our work on real-time captioning by the crowd (that is, converting speech to text with less than five seconds latency). Currently, the only reliable way to produce real-time captions is to schedule an expensive professional stenographer (automatic speech recognition still has abysmal accuracy in everyday settings). Our Scribe project is using a different approach—combining the contributions of multiple people who individually cannot type at natural speaking rates.

As part of the NSF CAREER Award that Jeffrey Bigham won this year, we are pursuing models of crowdsourcing that combine the efforts of multiple people together in real-time over longer-term interactions to complete diverse real-time tasks that individuals usually do. For instance, our systems temporarily outsource control of existing desktop interfaces to help blind people overcome accessibility challenges and allow crowds to serve as interactive personal assistants over instant messenger.

ROC HCI has been actively involved in the creation of the new digital media studies major at the University of Rochester. The major will provide students with the skills necessary to both produce innovative digital media and frameworks for critically analyzing it. Two of the introductory courses are modeled on existing courses taught by HCI faculty. DMS 102, Contemporary Media Production, will draw from our existing Web Programming course, and DMS 103, Human-Computer Interaction, will draw from the existing course. In conjunction, the new media building will provide students in a range of disciplines a place to work and access to state-of-the-art tools, everything the next generation of makers needs to hone their crafts.

We’re excited about where HCI is going at the University of Rochester and look forward to where we’ll be after another three years!



Typical VizWiz users' requests.



Photo: Naushad UzZaman cs PhD '12

RECENT PhDs

Tongxin Bai

Program Parallelization through Safe Dependence Hints and All-context Dependence Analysis
Aster Data

Qi Ge

Exact and Approximate Counting of Graph Objects: Independent Sets, Eulerian Tours and More
Google, Inc.

Satyaki Mahalanabis

Subset and Sample Selection for Graphical Models: Gaussian Processes, Ising Models and Gaussian Mixture Models
Google, Inc.

Ross Messing

Human Activity Recognition in Video: Extending Statistical Features Across Time, Space and Semantic Context
Tandent Vision Science, Inc.

Naushad UzZaman

Interpreting the Temporal Aspects of Language
Nuance, Inc.

Adam Sadilek

Modeling Human Behavior at a Large Scale
University of Rochester Dept. of Computer Science Post-Doctoral Fellow

Bianchini, Ricardo, PhD '95 "I was elevated to distinguished scientist by the ACM."

Blaylock, Nate, PhD '05 "Last month I moved to Montreal to join Nuance Communications as a principal research engineer. I am currently leading the research effort for the DragonTV product (dialog with your TV)."

Coombs, David, PhD '92 "I just returned from a Boy Scout trip to Alaska with my 17-year-old son. I also started a stint as a PM at IARPA last September. IARPA is similar to DARPA for the IC."

He, Bijun, MS '04 "I'm enrolled in the Berkeley-Columbia Executive MBA program and look forward to graduation at the end of this year while I am still working at Google. In addition, I also got promoted to the position of tech lead, leading the efforts to build the central user-targeting ads backend for Google Ads products, including Search Ads, AdSense, YouTube, DoubleClick products, etc. It has been an exciting year for me, and I am also preparing myself for the challenges ahead."

Hossain, Hemayet, PhD '10 "I was promoted to "senior architect" from "architect" in GPU architecture at NVidia. I'm working on Maxwell GPU architecture, NVidia's next-generation GPU after Kepler architecture. Kepler is the most powerful and efficient GPU ever built, and it is going to power Titan, the next #1 supercomputer in the world, at Oak Ridge National Laboratory."

Kaplan, Aaron, PhD '00 "In July 2011, after just about ten years at Xerox in Grenoble, I moved to New York and joined a startup called NewsCred. My title is lead software engineer."

Learn, Andrew, MS '01 is a senior cyberspace analyst for the US Air Force, Division of Concepts, Strategy and Wargaming.

Lui, Ding, PhD '10 "I was just promoted to "principal research scientist" at Nuance and was awarded the "Above and Beyond Creativity Award" at Nuance in 2011."

Michalak, Phil, PhD '11 "I've gone from being a senior research scientist to being director of research with Digital Reasoning Systems."

Miller, Brad, MS '86 "I'm now a senior scientist at GE Global Research in Niskayuna, N.Y. Research there I'm involved with spans complex adaptive systems (nee intelligent agents), robotics and metacognition (consciousness) with the last being most interesting but the first paying the bills so to speak. We're in the process of setting up some nice platforms for robotics work from mobilerobotics, and we'll be looking at issues involved in learning from the environment and managing close interaction with humans without the usual 'zones of death.'"



Purav, Chikita, MS '05 "I quit my job at Qualys to come to India for social work in 2010. I

served a two-year fellowship with Teach for India (similar to Teach for America) and worked in a low-income school for underprivileged children. I taught grades 3 and 4 and loved every minute of it. The children made tremendous growth, academically. For example, on average, my class showed 2.4 years growth in English in a single academic year. I completed my fellowship in April 2012. I am now working as the principal (head) of a school called Tamarind Tree in a village called Sogave (India). On the personal front, I got engaged this March and will be getting married the 10th of August this year."

Sabbah, Daniel, PhD '82 "I have changed jobs since the last time I sent in something (now GM, Tivoli Software). But still at IBM . . . and still in the software business."



years old, and we have a baby boy, Robert, who was born on Sophie's birthday last fall."

Shandilya, Abhiram, MS '02 "I've been working at Juniper Networks, Inc. located in Sunnyvale, Calif., since 2007. I climbed Kilimanjaro in March."

Swain, Michael, PhD '90 "I'm still working at athenahealth, and my current title is principal architect."

Tan, Wenzhao, MS '05 "I left Microsoft Research last year and started a company focusing on mobile app development."

Weber, Susan, PhD '89 "I am still at Stanford School of Medicine."

Wisniewski, Bob, PhD '96 "I was named ACM Distinguished Scientist and IBM Master Inventor, and I have recently left IBM Research and now work for Intel."

Yi, Weilie, PhD '06 is now working for a start-up company called Placed Inc. (www.placed.com).

Zaki, Mohammed, PhD '98 "I am the program co-chair for the 21st ACM International Conference on Information and Knowledge Management (CIKM), 2012, and the 12th IEEE International Conference on Data Mining (ICDM), 2012."

Zhang, Hao, PhD '08 "I am currently at the Google New York office, working on natural language parsing and machine translation. After a promotion last year, I am now a senior software engineer. In my personal life, my wife, Lin, and I had a baby girl, Grace, last year. She's giving us happiness every day."

Zhang, Yilian, MS '02 "I am currently an associate professor of mathematics and computer science at the University of South Carolina, Aiken."

If you graduated in a year that ends in 7 or 2, please join us Meliora Weekend, Oct 12, 3:30–5:30 p.m., for the Computer Science Undergraduate and Graduate Reunion Open House in room 601 of the Computer Studies Building.

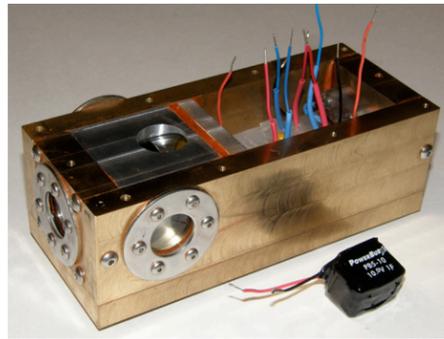
Please join "URCSD Alumni" on LinkedIn and Facebook



LOOKING TO THE FUTURE

URCS Undergrads Build 1,000 Year Artifact

By Randal Nelson



Students in Randal Nelson's CSC 200 Undergraduate Research Seminar spent the semester designing and building an electronic device that would keep working for 1,000 years.

Specifically, the goal was to construct a gadget with the following properties:

- (1) It contains information readable without external technological infrastructure.
- (2) It contains a self-powered electronic component.
- (3) It will remain continuously functional for 1,000 years (not a time capsule).
- (4) It will survive everyday slings and arrows (getting bumped, dropped, wet, etc.).
- (5) It will fit in a pocket and have an attractive appearance.

The idea behind the somewhat unconventional (for computer science) project was to introduce research (the topic of CSC 200) by dumping everyone out of their programming comfort zone. Since research is basically finding out about the unknown, the first step is getting to a place not written about in the books. Senior Donato Borrello and junior Amsal Karic, who worked on the website documenting the project, said, "The first weeks of class, we decided on a challenge that would require us to branch out from everything that we, as computer science majors, are already familiar with."

The CS/information science inspiration behind the project was the temporary nature of most digital information. Bits saved to physical media tend to degrade over time, and the effect of degradation is catastrophic compared to traditional printed material. In compressed formats, damage to even a few bits can render the content unintelligible. Even if the bits are undamaged, it can be difficult or impossible to read physical media more than a decade old because formats and standards have changed and the devices needed to read the old ones are no longer manufactured. And even recovering the bits is no guarantee of success. Many formats have proprietary components that (unintentionally) provide pretty effective security through obscurity.

So, basically, no shoebox of digital photos in grandma's old hard drive or camera chips. There are two obvious approaches to the problem. The first is to store digital information in professionally run (and legally regulated) "Data Banks," which take responsibility for keeping everything accessible and backed up. The other is to store information on durable, self-contained devices that contain everything needed for reading it (e.g., books). The first is what will probably happen. The second sounded like fun.

The class formed four teams focusing on different, though not entirely independent, sub-problems:

- (1) durable physical housing,
- (2) self-contained power supply,
- (3) electronic functionality, and
- (4) information content and access.

There were certainly technical challenges. The housing team had to learn metalworking, which has some differences from computer programming. Sophomore Connor Bohan said, "I learned the virtue of

not 'eyeballing' it. In (programming) one can start coding not entirely knowing what they are planning to do. A project can be modified while it is being worked on. When this strategy is applied to metalworking it falls apart. Unlike programming, mistakes can't be undone." The electronics team had to learn to design and analyze the power requirements of circuits—and to solder them. The power team learned that the solar power available is not exactly what the cells advertise. And the information team had to settle for a non-digital format—though they used digital technology to generate the product.

Overall, however, the class agreed that the most challenging aspect of the project was not any particular technical problem, but human communication within and between teams. There was more work than any individual could accomplish. Organizing it so that the group could accomplish it was another challenge. As junior Ben Clifford put it, "The most challenging part of the project was dealing with other group members. It was up to the groups to organize. We (initially) relied on email almost exclusively. However, it became all too easy for group members to simply ignore emails. Eventually we began assigning work in person, where communication was guaranteed."

The completed artifact does fit in a (large) pocket, though you wouldn't want to carry it there for long. It resembles, perhaps, a steampunk sarcophagus, done in bronze and stainless steel. It is currently on display in Marty Guenther's office (CSB 735) window, happily blinking away. Will it blink for 1,000 years? Only time will tell.

A detailed description of the project is online at www.cs.rochester.edu/users/faculty/nelson/courses/csc_200/project_2012_site/.



Bob Swier immerses himself in Japanese culture.

GEEK CULTURE ATTRACTS CS ALUMS TO JAPAN

By Marty Guenther

Silicon Valley would be a likely place for Rochester computer science alumni to migrate after completing their computer science degree, and many of our students do find themselves headed to the West Coast after graduation. However, there is also something pulling our students across the Pacific Ocean all the way to Japan each year. What's the attraction for computer scientists to the language and culture of Japan?

Most students agree that one commonality many CSC/JPN students share is an interest in geek culture, including video games and Japanese anime. For those so inclined, there is an anime club on campus and a course through Modern Languages and Cultures that many CSC students take for a humanities cluster, minor, or major. Professor Joanne Bernardi from the Department of Modern Languages and Cultures confirms that most students who double major in JPN and CSC take at least one of her courses in Japanese popular culture (e.g., film, various courses in Japanese anime, or animated films). Some prospective students even choose to come to the University because Japanese is available and they have an option to study abroad in Japan. Others cite the strong, enthusiastic Japanese faculty at Rochester that strengthened their interest and excitement about the language and culture.

In Japan, the higher education system is different from U.S. colleges. After a difficult entrance exam that is very selective, students breeze through college without much work and get more specific on-the-job training once they are employed. Per Rintaro Kuroiwa '12, Japanese companies only want to hire employees directly out of college so that they are trained specifically for that company. However, students who have graduated from programs like URCS have a greater understanding of computer science both in breadth and depth than typical Japanese graduates and could be at a competitive advantage in that market.

Job opportunities in Japan often begin with the JET Programme (Japan Exchange and Teaching Programme), which selects students to fill positions as eikaiwa (or English conversation) teachers. Recent grad Edith Hanson '12 will be in Japan through this program for the next year. Bob Swier (BS '01, MS '02) chose to teach English as a foreign language at the university level on a more permanent basis. He left his high tech skills in Natural Language Processing behind but has never been happier. For those interested in staying in tech fields, computer skills become an important asset for them because, as in the United States, computer skills are in high demand in Japan.

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MEDICINE GOES HIGH TECH WITH COMPUTER SCIENCE ALUMNUS

By Marty Guenther

Prakash Viswanathan is not your typical computer science nerd. After graduating from the University of Rochester with a double degree in computer science (BS) and biology (BA) in 1998, he headed into the computer consulting industry working as a programmer analyst at American Management Systems. As with many double majors in computer science who eventually migrate to their other interests, it was easier to get a job in a technical position during the dot-com boom. But that all changed after two years of consulting work.

Though medical school was always a possibility (he took the MCATs while still at Rochester), after two years working as a programmer, he came to a decision point—grad school in CSC or medical school. He felt his experience as a computer consultant would bolster his medical school application as it showed a diverse set of skills from the typical biology/pre-med applicant. He took a chance and applied. Fourteen years after graduation from Rochester, he has completed medical school, his internship, his residency, a stint as chief resident, and a gastroenterology fellowship and is now ready to begin work as a GI attending physician at a Long Island hospital.

Prakash credits the research he completed while at Rochester under then computer science faculty member Kyros Kutulakos (jointly with the Department of Dermatology) with adding to the strength of his medical school application. Though that research wasn't relevant to his current field, he recommends that anyone interested in a career in medicine would be well advised to take advantage of undergraduate research opportunities at Rochester. Medical school application committees put great value in undergraduate research in their admission decisions.

Prakash wasn't sure what area of medicine he would find the most interesting. He chose the field of gastroenterology while doing his clinical rotations because it is a procedure-oriented field. He was fascinated by the minimally invasive internal examinations, the hands-on approach that endoscopy provides for diagnosis and treatment, and the recent advances in endoscopy that allow a GI doctor to perform procedures in lieu of surgery. He explains that technology in his field of medicine is advancing in significant ways. Electronic medical record systems are being implemented throughout the country in response to a federal mandate by Medicare and Medicaid. Medical practices not using electronic charts will be penalized if they are not online by the end of 2012.

Aside from medical records, doctors are joining with computer scientists to create intelligent assistant smart phone apps to improve communication between doctors and patients related to chronic gastrointestinal symptoms. Software companies are developing better user interfaces for patients who use smart phones to report problems to their doctors. The endoscopes are getting more efficient in size and speed, but there is still room for improvement for data collection and analysis. One software company making important advances in the GI field is the result of collaboration between a computer scientist and a doctor. There is much yet to be discovered in medicine, and advancing technology will play a significant role. Collaboration across disciplines and effective user interfaces will be the key.

The BS in computer science at Rochester was the ideal combination of problem solving and research experience to prepare him well for a medical career. Prakash believes that his computer science undergraduate degree enables him to problem solve differently from many of his colleagues. Although many doctors rely on recall of past memorization to diagnose their patients, Prakash uses a combination of recall and logical problem solving, which brings the whole picture together. "It's a more efficient method to use both," says Prakash. He was also well prepared for the demanding rotation schedules of a medical intern/resident because of the many nights he spent in the major's lab in the computer science building. "I still remember the all-nighters I did in the major's lab the day before a program was due. It definitely prepared me for 24-hour shifts!"

Prakash hasn't totally forgotten his computer science roots. He occasionally modifies existing software packages to make obtaining chart data more simplified for the other physicians. Also, Prakash still spends some of his spare time tinkering with his computer. Most of all, he and his wife spend their free time with their one-year-old daughter, Krithika. Although computer science isn't his primary focus on a day-to-day basis, as the technological advancements continue in his field of medicine, he will be comfortable adopting the technologies involved. The geek in him is still there, even if he's disguised in a white lab coat with a stethoscope.

Geek Culture (con't. from page 9)

Culturally there are several adjustments Americans must make in Japan. Per Franklyn Tamalonus '01, who has recently returned from working for 10 years in the gaming industry in Japan, there are several significant differences. On a positive level, there is very little street crime, and people are respectful to others. There is no tipping in restaurants, taxis, etc., but the cost of food, housing, entertainment, parking, and transportation is quite high. And then there is the expected overtime. Alex Golden '03, who has been living in Japan since he began in the JET Programme after graduation, says, "The biggest difference I had to get used to was the volume of and attitude toward overtime work. At most companies where I have worked while in Japan, it seems like overtime work is a given, regardless of how necessary it actually is." Bob Swier says more young people smoke in Japan, unfortunately, and there are fewer smoking restrictions there compared to the United States.

On the corporate level there is less upward mobility, less acknowledgement and compensation for individual successes, fewer start-up opportunities, and more top-heavy corporations. Though the Japanese companies want to hire Americans to help bridge the language and culture gap between the two economies, the societal differences sometimes make changes difficult to implement.

However, the country still holds a certain charm to those who settle there. As Alex Golden said, "I love everything about the different culture, from the language to the small temples and shrines you can find just about anywhere. I especially love the summer festivals and hanami (cherry blossom viewing picnics). I never experienced anything like that in the states."

For some, a little romance plays a role in the infatuation with Japan. Golden's wife, Kay Watanabe, is Japanese. Bob Swier writes, "I was only vaguely aware of the existence of Japan until I met another Rochester CS major who happened to

be taking Japanese. We eventually visited Japan together, and my initial impression of the country was just incredibly, incredibly positive. I also remember that, around a year before that, I was living in Susan B. Anthony Halls, and my Indian roommate had a group of friends that included a very beautiful Indian girl. I sometimes joke that if that girl had liked me, I'd be living in India now. :-)." One can't deny that affairs of the heart can play a role in this as well.

All the students agree that seizing an opportunity to study or work abroad, whether it's Japan or anywhere else in the world, will teach you a lot about yourself as well as help you gain a new perspective on life, politics, and the world. As Swier states, "The world is smaller and more connected than it used to be, but it is far, far larger than just the United States. To really see that, though, I think it helps to go somewhere longer than just on vacation." Perhaps a computer science degree is your ticket to experience the world!



Viswanathan with his family.

Abbey, Macy '07 "Recently I've been traveling (Hawaii, Vietnam), spending time with my girlfriend of almost two years now, and I just started my own Software Development Services business, CodeCaptain LLC. Oh, and I got my own bobblehead!"



Abernethy, Max '08 "I've moved to San Francisco, and I'm now with Havok Games."

Abraham, Sunil '00 "In terms of announcements—my son, Thomas Peter Abraham, turned one on June 21, 2012."

Acharya, Athul '06 "I've actually moved to Durham, N.C., for law school at Duke University School of Law."

Barnett, Elliot '97 "I just launched a software consulting business called ECM Consulting Solutions (www.ecmconsultingsolutions.com/)—so it has been extra busy trying to get my first contracts in place. I'm still looking to fund StoreTraxx—I'm going to be pursuing that heavily over the next 6–8 months—that's part of the reason I'm doing consulting so I can stay nimble through that process. I'm 100 percent on my own now . . . so no more jobs . . . only business!"

Begley, Niall '08 "I left my previous position at Lockheed-Martin in Syracuse since my wife got into a residency program at Yale. I got a new job here in New Haven at a company called Dataviz that develops iPhone/Android apps. On May 7, I married my girlfriend of 7.5 years that I met and started dating within the first couple months of attending UR."

Bhopale Plaisir, Seema '04 "Over the past year, I have continued working as a bioinformatics consultant with Dr. Delphine Lee studying melanoma and other skin diseases at John Wayne Cancer Institute. I'm pleased that my work will be included in two upcoming publications. My husband, Chris, and I have a daughter, Aashna, who turned two years old, and we are proud and amazed every day by her growth and tenacity."

Bijlani, Rahul '02 "My partners and I (including Alec Shtromandel '02) recently built and opened the Union Hotel in Brooklyn—it's a boutique property, and you are all invited to check it out the next time you're in New York City! Meanwhile, I have returned to my CS roots somewhat by joining a small Commercial Real Estate CRM company—Apto—as an advisor. And September will mark the three-year anniversary of going 'Paleo'—applying evolutionary biology to nutrition and exercise. Basically this means avoiding processed foods, sticking with meat, vegetables, fruit, and nuts, and constantly varying exercise. It's been 10 years since graduation, and among other things UR I remain part of the UR Tae Kwon Do extended family, led by Grandmaster Ray Mondschein, who still teaches on campus! Hope to hear from any URCS alums visiting Houston."

Brill Albright, Ingrid '02 "I've continued to work at Orbit Logic, writing software for imaging satellite collection planning. I'm enjoying my work, and we're starting to develop some apps (iPhone and Android) as well, which has been fun to learn. The big life event this year is that Shane and I are happy to announce the arrival of our first baby, Anneliese Marjorie, on August 9, 2012."

Brown, Cole '11 "I left my job at FactSet to pursue the startup life at Codecademy (www.codecademy.com). Our CodeYear initiative (www.codeyear.com) has gotten 450,000 pledges to learn to code—even though many will not finish, it's a great sign for both us and the thousands of people, all over the world, eager to pick up new and relevant skills."

Camara, Ross '04 "I'm still in the Washington, D.C., metro area but now working for Booz Allen Hamilton doing software development for government clients with a focus on User Interfaces. In my personal life it was a big year as my wife and I welcomed our first daughter, Melanie, who was born in August 2011. It's been a crazy but great year learning to become a parent, far more challenging than trying to debug intermittent UI crashes."



Carlberg, Jason '03 "As far as news, I was married on June 9! My lovely wife, Natalie, is a coworker and fellow Software Engineer at Infogroup. She does GUI development while I do Linux server back end work. In fact, in attendance of the wedding here in Omaha was a fellow member of my class, Charles Balconi '03!"

Chang Hirikami, Allison '01 "We had our second son, Nikko. (Kazuo is making a face on the left, and Nikko is on the right.)"



Chang, Lewis '02 completed an MBA in May from NYU's Stern School and is now working as a Technical Account Manager at Google.

Christopher, Ian '10 "I've graduated (MS, Stanford), and I'm now working at a stealth (healthcare IT) startup I cofounded with a few friends."

Collins, Marty '10 is now employed at Thomson Reuters.

Coimbra, Hilario '08 "After working at Cambridge startup Vlingo for almost four years after graduating from UR, I have moved on to a new

venture. My time at Vlingo was great, and I grew from software developer to product manager there as I discovered a passion for product design. After the company was acquired by Nuance, I decided to look around for another startup in the Boston area. Just a few short weeks ago I joined a company called Abine as a product manager. It is a 25-person startup in the consumer privacy space. This is a fascinating area to be in right now, and especially timely with the Facebook IPO and all the privacy talk surrounding that. Hopefully we'll make an impact in the space by helping consumers understand and control the information that is gathered as they browse the web."

Dagen, Justin '02 "I'm returning to Rochester after two years in the Washington, D.C., area working with the NRO (National Reconnaissance Office). I will still be working for Lenel (eight years and counting!) and continuing to do software development there. Not sure if I let you know last year, but I married Corinne Carpenter '03 (now Dagen) last May!"

D'Eredita, Ross '04 "I am currently a senior financial analyst intern at Best Buy in their Enterprise Capital Evaluation group (what a mouthful!). Basically, it's a corporate finance role in their treasury department evaluating their store portfolio."

Easwaran, David '04 "I got engaged last summer to Kate Reichert and will get married this coming September. Also, I just changed jobs a few months ago. I am now a patent attorney at Oliff & Berridge, PLC."

Elsner, Micha '05 "I will be leaving my postdoc at Edinburgh to start a faculty position in OSU linguistics this fall. (Seriously . . . unbelievable luck.)"

Feil-Seifer, David '03 "I received an NSF Computing Innovation Fellowship in 8/11, defended my dissertation in 10/11, started as a postdoc at Yale, received the USC CS Department's 2012 Best Dissertation Award in May, and received the USC Order of Arete for May 2012. I also got engaged to Vicki Litz '03 in February."

Frankel-Goldwater, Lee '06 "I'm currently living in NYC participating in NPO work, holistic practices, and using technology for the greater good . . . and my enjoyment whenever possible."

Friedman, Alex '08 is self-employed writing iPhone and Android apps.

Frueh, Andrew '03 "I was promoted to creative director at Infuse Medical in Salt Lake City last October. Also finally finished and screened my thesis film last year to complete my Master of Fine Arts from RIT (<http://kikimasufilm.com>)."

Glaser, Harry '07 "I'm cofounding a startup with Tom O'Neill in San Francisco."

Gorenstein, Aaron '11 "I was a 2012 Hertz finalist. Not a recipient, so I don't get any money, but I was in the top 50. Things are going well (as

PhD student at U. Wisconsin) in Madison. I am spending the summer under an RAship with Lane's old friend Professor Jin-Yi Cai, and hopefully I will do some crazy research stuff."

Gross, Daniel '04 "Last month I bought a townhouse."

Hamilton, Jeff '01 "Amy Hamilton '06 and I had our second son, Tyler Edward Hamilton, on April 30, 2012. Amy and Tyler are doing well, and Wyatt is very excited to be a big brother."

Harrington, John '07 "I am currently working at FactSet Research Systems, in Norwalk, Connecticut."

He, Zaiming (Michael) '06 "I am still working at Travelers in the role of Product Manager in the Select Catastrophe Strategy team."



Heavey, Brendan '02 "I'm still in Buffalo and have been with Independent Health for a year now. I enjoyed the St. Patrick's day parade immensely this year in my adult-sized Leprechaun suit."

Hilton, Rod '04 "I'm one year into a PhD program in computer science at the University of Colorado in Denver, and I'm now working at Time Warner Cable as a software engineer."

Ho, Brian '12 is working at Grandtag Financial Group in Hong Kong.

Immerman, Brian '04 "I'm excited to share that I was ordained a rabbi on May 5 at Hebrew Union College, and I have moved to Denver to be the assistant rabbi at Temple Emanu'el. I'm very excited."

Karr, Daniel '05 "I graduated last year with an MBA from the Thunderbird School of Global Management. I'm now back in Washington, D.C., working for an exciting boutique consulting company called SemFin Group. We specialize in cutting-edge enterprise planning and financial analytics systems for government contractors and project-based organizations. For fun, I've been keeping up my globetrotting and have most recently been traveling to countries across Europe, Africa, and Asia."

Keesom, Jeff '08 "I received my Juris Doctor from the Syracuse University College of Law and Master of Public Administration from the Maxwell School of Syracuse University in May. I will be joining Deloitte Consulting LLP in August as a Consultant in their Washington, D.C., office, doing national security-related consulting work for federal clients."

If you graduated in a year that ends in 7 or 2, please join us Meliora Weekend, Oct 12, 3:30–5:30 p.m., for the Computer Science Undergraduate and Graduate Reunion Open House in room 601 of the Computer Studies Building.

Kenney, Jeff '01 "I'm approaching my 15-year mark in the Navy now. I finished my master's at Johns Hopkins a few years ago, and I am currently halfway through the PhD program at George Mason. I just seem to take a few years break between school every now and then based on what the Navy has me doing."

Kim, Eli '03 "I actually ended up leaving the comp-sci field after college and got a doctorate in pharmacy to take over the family business. I'm currently living in Manhattan and managing pharmacies and commercial real estate."

Kollar, Thomas '04 finished his PhD at MIT in May 2011 and is now a postdoctoral fellow at Carnegie Mellon University.

Laird, Edward '08 "I took a job with Sigma International General Medical LLC last September. We were bought by Baxter International in April. I'm currently working for them writing embedded software for their Spectrum IV infusion pump."

Lambe Jr., Dennis '03 "My friends and I received an art grant to complete construction on Rock Inferno, our flame-throwing Guitar Hero game. Information about that and photos can be found here: www.arsoniccreations.com/rockinferno.shtml."

Liveikis, Ed '01 "I've moved to Prague in the Czech Republic with my family. I'm working with remote developers across Europe, New York, and California creating games and entertainment apps—both contract gigs and internal development."

Luis, Cristina '01 "I'm teaching at a school here in Oslo, Norway, and we'll be here for at least another year. It's great to live in a city with such fantastic access to the outdoors!"

Margolis, Benjamin '05 "I moved to NYC from Boston and am doing web development at the Manhattan office of California Cryobank. With my band, The HeartSleeves, I released my first album, Peripheral People. Right now I'm in the process of buying a co-op in Riverdale."

Marino, Dominic '05 "I married UR alumna Tatiana last June. I left my job at Raytheon this past February. I then joined MathWorks in Natick, Mass., where I work on sporadic failure analysis and testing for MATLAB, which I'm pretty sure we all used back in Rochester. While I was still at Raytheon I spent a lot of time in the Utah desert working on a radar called JLENS—if anyone was way out west in the middle of nowhere and saw an ominous white blimp in the desert sky between Utah and Nevada, that was us!"

Meeker, Brian '07 "I am now enjoying the freedom of working from home as an independent contractor. I'm currently doing contract work for Real Life Industries, a startup cofounded by CS graduate Pam Vong '08."

Moldover, Jonathan '99 "I've started working at Sonic Mule www.smule.com on mobile musical apps for iPhone and Android. Fun stuff."

Mullowney, Dan '07 "I left Microsoft to move to the Bay Area to work at Google. I'm working as a test engineer on the backend APIs for the Google Wallet team. It's great to be near more Rochester alumni and also tons of great tech opportunities."



Norine, Christopher '09 "In September 2011 I was officially designated a Naval Flight Officer and packed up and moved to Lemoore, Calif., to report to VFA-122

to train to be an F/A-18F WSO (Weapon Systems Officer). I'm going to carrier qualify at the end of June and hope to report to a fleet squadron either here in Lemoore, or in Oceana, Va., by the end of the summer. And attached is a picture of my office. I'm in the back seat of the plane that is about to get some gas."

O'Neill, Tom '07 "I'm cofounding a startup with Harry Glaser '07 in San Francisco."

Orlando, David '03 "I married Elena Edelman in October of 2011 in Washington, D.C. Fellow CS alum Justin Ward was a groomsman."



Panagiotopoulos, Diane '09 is working for Amazon in Seattle.

Pandina, Matt '06 "I got married on 10/10/10, and we now have a 10-month-old daughter. I'm still with the same people in Reston, but we were bought by WebSideStory, then by Omniture, then by Adobe. So while I'm still part of the same team, I'm actually working for Adobe now."

Peramunage, Dasun '06 "I'm currently starting my second year of medical school. Lately, I've been giving some thought to a surgical specialty. I'm keeping an open mind about what I want to do until I complete some rotations in my third year."

Pershing, John (Jake) '10 "Kate and I are getting married on September 15 of this year; we're having a lot of fun finalizing the details. I'm still working at 1010data where I recently received a promotion to senior software engineer and am managing the client side technology team."

Qureshi, Omar '97 "I started a new role as a technology architect at Ex-

actTarget, Inc. in February 2012. ExactTarget is a global Software as a Service (SaaS) leader that powers all types of interactive marketing messages through a single, integrated platform. I am currently based in London."

Riffle, Mike '07 "Currently, I'm working at ChromeRiver, an Expense Management and Invoicing software company in LA. I'm doing some automation and development stuff (MySQL, Java, RiaTest, Python, PHP). I'm taking improv classes and I recently booked a leading role in a pilot for a web series, so . . . I'm keeping busy :)"

Rotondo, Mike '07 "I left Google in 2010 to go to Stanford's Center for Computer Research in Music & Acoustics (ccrma.stanford.edu) for an MA in music, science & technology. I just finished that up and also just launched Creatura, a giant interactive exhibit (creativity.org/creatura) at the Children's Creativity Museum in San Francisco with my friend Luke Iannini, with whom I'm now starting a company called Tree."

Rubin, Gregory '05 "I returned to Amazon Web Services from Google and am now a senior security engineer. I married Sarah Miller on September 25, 2011. We purchased a house in Seattle."

Ruskin, Jon '06 "I've been working at a new job since last October at an online creative agency, Tag Creative Studio (www.tagcreativestudio.com). I've been working on all sorts of high-level software goodness—websites, database design, and, more recently, 3D gaming as well as Kinect integration with different types of platforms (apps, games, etc.). I've also picked up a 'moonlight' job as a trainer at a local Crossfit gym in Scottsdale. Life is busy. Life is good. :)"

Rutar, Nick '01 "The company I work for is now called 'Applied Communication Sciences.' I'm doing a lot of cyber security research nowadays. Most of it is for the government, so although it's super cool stuff, I can't say too much about it."

Sawhney, Veneet '03 "I got married a little over a year ago and have been working for Circuits and Systems in Long Island, N.Y., for three years."



Scarantino, Michael '00 "I'm working for a company in Denver at the moment, doing database development and reporting."

Schmitt, Ryan '09 "I am working at Amazon and just bought a condo in Seattle."

Schmid, Jonathan '03 "I'll be spending another year in the Vision lab at the Naval Postgraduate School in California working on some significant projects for the Navy. Loving the ocean: bodyboarding, snorkeling, and maybe even SCUBA diving soon."

Sedney, Nicholas '08 "I'm an SDET at Amazon."

Shah, Ruchin '02 "I am running my family-owned business in the diamond jewelry industry (Hetal Diamonds Inc)."

Sharif, Shumon '02 "I moved from NYC to DC, bought my first house, and managed to get married, all within the past year! On the work front, after having been with Accenture for about six years, I recently joined Red Hat."

Turner-Trauring, Jenine '03 "My daughter Ada was born in April 2012."

Uzilov, Andrew '05 "My wife, Kathleen, (also a UR alum) and I are both nearing completion of our PhDs at UC, Santa Cruz, and we are expecting our first son in July! I am looking for post-graduation jobs on the East Coast, while continuing to juggle several ambitious bioinformatics projects. I also wrote a book chapter (in press) on FragSeq, which is a novel high-throughput method for RNA structure probing for which I developed core algorithms a couple of years ago."

Vayanis, Andrew '05 "I am now working for Riot Games based in Santa Monica, Calif., as a senior software engineer."

Ward, Justin '03 "I'm happy to report that I've recently started working at a (funded!) startup in NYC named 'NewsCred.' We're essentially a next-generation news wire, receiving full-text news content from English-language publishers all over the globe and reselling it to app makers, digital brands, 'traditional' online news outlets, etc. The company is doing very well and continuously on the lookout for talented computer people. One of our developers here is also a URCS alum, Aaron Kaplan (PhD '00)."

Weingarten, Tom '06 "In January, I successfully defended my PhD dissertation, "A Multi-Sighted Approach To Bridge The Gap Between All-Atom And Coarse-Grained Force Fields." After my defense, I began working as a cofounder and CTO at Delve News, a startup company building a team newsreader to help organizations discover and discuss the news. In my spare time, I lead bereavement groups for local children at A Caring Hand, The Billy Esposito Foundation, in New York City."



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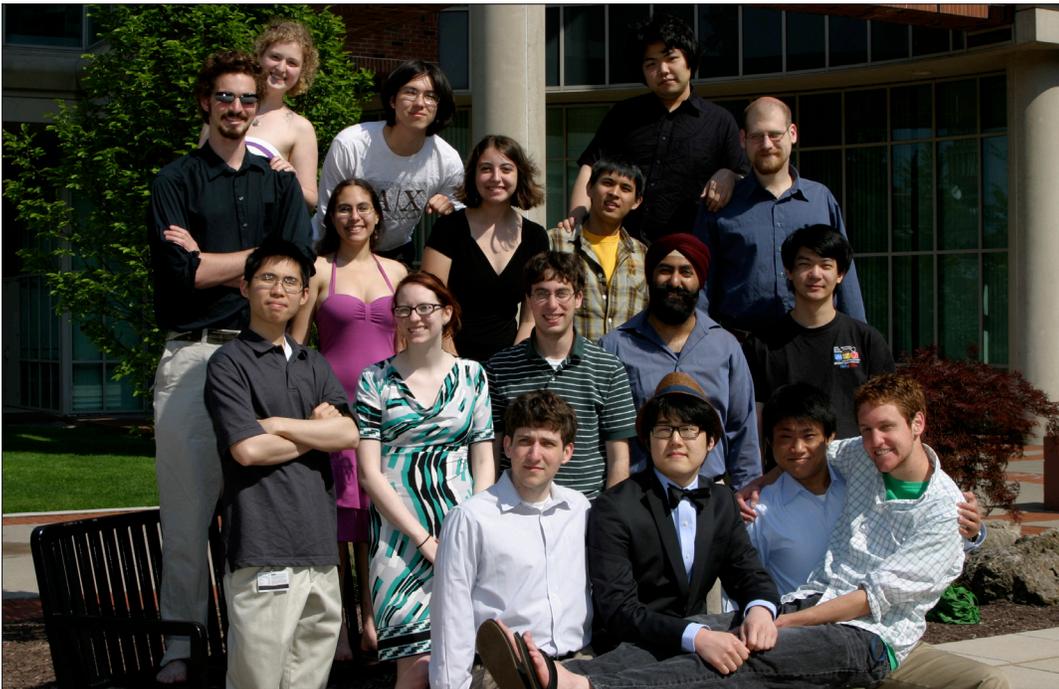


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Class of 2012: **Front row, left to right:** Zachary Fletcher, Robert Yoon, Piset Virachunya, Harry Ledley; **2nd row:** Jason Zhu, Chelsea Flint, Bradley Halpern, Preetjot Singh, Xiaoqing Tang; **3rd row:** Joshua Pawlicki, Darcey Riley, Adina Rubinoff, Jungo Sasaki, Sam Atlas; **Back row:** Edith Hanson, Benjamin Nicholson, Rintaro Kuroiwa. **Not pictured:** Aaron Berkowitz, Donato Borrello, Kevin Brice, Kyle Edwards, Zhijing Feng, Jason He, Erica Hyman, Brian Ho, Kyle Murray, Dan Panzarella, and Samuel White.

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