The School of Mark

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PEERING BEHIND CHINA’S ‘GREAT FIREWALL’
RESEARCH NOTEBOOK: DOES ‘DESIGN THINKING’ IMPROVE RESULTS?
The Link provides a mosaic of the School of Computer Science: presenting issues, analyzing problems, offering occasional answers, giving exposure to faculty, students, researchers, staff and interdisciplinary partners. The Link strives to encourage better understanding of, and involvement in, the computer science community.

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This past summer, I had the opportunity to attend alumni events in Boston, San Diego, San Francisco and Seattle. For the past several years, the School of Computer Science has teamed up with the Electrical and Computer Engineering Department to organize these events.

This has proved very successful, because many CS and ECE alumni interacted with each other as students, and they tend to end up at similar companies, pursuing similar career paths.

I find these meetings with former students to be truly inspiring. Their career paths go in many different directions, including big companies, startup companies, government service and academia, but in all cases they are excited and enthusiastic about what they are doing.

I also continue to be impressed by how consistently they state that their Carnegie Mellon education has served them well. Not only did they learn useful technical material, they also learned how to dig in, build things and make them work.

That willingness to take initiative and to work both smart and hard is something we all experience here at CMU, and it’s good to see it moving out into the world via our graduates.

Randal E. Bryant
Dean and University Professor
School of Computer Science
I can’t praise highly enough your article about Hans Berliner in the Spring 2012 issue. May I offer a few of my own reminiscences?

The arrival of a world chess champion in Pittsburgh had the same galvanizing effect on Pittsburgh’s tournament chess players that the arrival of grandmaster Alex Shabalov had 20 years later. In 1973, when I arrived at CMU, Hans’ name was on my friends’ lips, and I soon obtained a copy of an article he had written about chess openings—the genesis of the book he wrote decades later called “The System.” I read it, and was influenced by it in my own choices of openings.

I had written a chess-playing program as an undergraduate, and that had probably been a factor in getting admitted to the computer science doctoral program, but I didn’t continue down that path for my research, and so I never worked with Hans. We met almost weekly, however, in the lounge, to review the New York Times chess column.

He played in one tournament in which I played, in 1974; and in 1975, we played in one match on the CMU team in the Pittsburgh Chess League. That was his last serious chess, however. I now understand why someone might retire from chess; back then, my mind could comprehend it, but not my heart.

Hans wrote a 12-page monograph about the opening variation of one of his famous correspondence games, which he entitled, with characteristic iconoclasm, “From the Deathbed of 4. N-N5 in the Two Knights Defense.” I took it to tournaments and sold it. At the 1978 Master Challenge in Chicago, it flew out of my hands, but after that I didn’t have as much luck. The variation continued to be topical, and several years later he published a revised version.

It’s easy to recall conversations with Hans. He was an iconoclast in person as well as in print. His short stature and his smile only made this trait more appealing.

His current assessment of “the whole AI thesis” from those days is a little harsh. All the research we did back then, not only AI, was deeply colored by the puny computing power that we had available to us. In the 1970s, research into speech recognition and synthesis funded much of the CS department, but reviewing the research from those days after using Siri feels like looking through a telescope in the wrong direction. And so it has gone with chess.

The case of Hitech was particularly poignant because its turn as king of the hill was so short. But faster hardware doesn’t make domain knowledge irrelevant; today’s software still needs domain knowledge.

Bruce Leverett (CS’81)
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Looking behind China’s ‘Great Firewall’

A statistical analysis of apparent censorship on China’s Sina Weibo network may reveal more than the deleted messages themselves.

By Jason Togner

When NBC time-delayed U.S. broadcasts of certain competitions in the Summer Games, disgruntled fans turned to social media to follow their favorite sports in real time, leading some analysts to call 2012 the “Twitter Olympics.” According to Advertising Age magazine, during the opening ceremonies alone, about 10 million tweets were sent. (Indeed, some of those tweets were from people complaining that NBC itself was live-tweeting about things that the network wouldn’t show for hours later.)

Meanwhile, in the People’s Republic of China, Advertising Age reports that users of the homegrown Sina Weibo social media network sent some 119 million tweets during the opening ceremonies, “making a strong case to call this the Weibo Olympics as well.”

Weibo means “microblog” in Mandarin. Sina Weibo is similar to Twitter (including a 140-character limit), but also allows users to attach files, and offers the Facebook-like ability to show comment threads. It’s not as well known as Twitter among non-Chinese speakers, in part because an English-language version (although announced) isn’t yet available. Within China, however, Sina Weibo controls well over half of the country’s micro-blogging traffic and its users include prominent international companies and celebrities; outside China, the site is popular throughout Asia and among Chinese speakers in the U.S., including an increasing number of CMU students and faculty.

Like Twitter, Sina Weibo’s wide user base makes it a perfect platform to study trends in language. David Bamman, a Ph.D. student in CMU’s Language Technologies Institute, opened a Sina Weibo account in 2011 and started using the service as a research tool to study differences in Mandarin and Cantonese dialects. In June and July, when rumors began to circulate that former Chinese president Jiang Zemin had died, Bamman opened a feed to read those messages.

Imagine his surprise a few months later when he re-opened the feed to find that most of the messages were gone, replaced with the ominous sounding note, “Target Weibo Does Not Exist.” Immediately, Bamman saw a whole new area for research.

Along with Noah Smith, associate professor in the LTI, and Brendan O’Connor, a Ph.D. student in machine learning, Bamman downloaded 56 million messages from Sina Weibo, then sampled 1.3 million messages three months later to see which ones no longer existed. The resulting study by Smith, Bamman and O’Connor, published in March, constitutes one of the first statistical analyses of the results of the Chinese government’s attempts to censor or shape public opinion using social media.

“All companies have some sort of internal controls,” O’Connor points out. Indeed, U.S. Internet providers routinely clamp down on copyright violations, piracy and trafficking in illegal material. Some companies censor for self-serving reasons; Twitter was roundly attacked for temporarily closing the account of a journalist who was sharply critical of NBC’s coverage of the Summer Games.

But speech laws and regulations in China are such that Sina Weibo and similar services inside the country are subject to political censorship as well. Facebook, Twitter and other Western social media sites have been banned from China since July 2009, when the services were used to distribute photos and first-person accounts of rioting in the northwestern city of Ürümqi. The Chinese blockade of Western social media has been dubbed “the Great Firewall of China.” Time magazine reports that Chinese search engines won’t return links to content on sensitive subjects such as the 1989 Tiananmen Square protests or Tibet’s bids for independence.

Sina Weibo is a Chinese counterpart to Twitter. Founded in 2009 by Shanghai-based SINA Corp., Sina Weibo had more than 300 million registered users as of February 2012,
or about 30 percent of all Internet users on the Chinese mainland. Outside observers have assumed that Sina Weibo was either self-censoring or submitting to government censorship of sensitive topics. To test that theory, in December 2010, New York Times editorial columnist Nicholas Kristof opened a Sina Weibo account and in his very first Weibo, asked, “Can we talk about Falun Gong?” Falun Gong is an underground religious movement officially banned in China. Kristof’s account was shut down within an hour.

Smith, Bamman and O’Connor found that Weibos about certain sensitive topics, such as Falun Gong, were deleted almost—but not quite—uniformly. Weibos about former Chinese leaders or political exiles were usually deleted as well. Since Weibos contain geographical tags, the survey team was able to determine that Weibos from Tibet were deleted at a much higher rate than Weibos from other regions; about 50 percent of Weibos from Tibetan users were deleted, versus about 16 percent for all Weibo users.

But a few topics that rated deletion by Chinese censors surprised the researchers. Following the nuclear accident at Fukushima in Japan, rumors spread around the world, including on the U.S. West Coast, that iodized salt would prevent radiation poisoning. Actually, iodine tablets, not iodized salt, are prescribed to protect the thyroid glands from being damaged by radioactive fallout.

Smith, Bamman and O’Connor found that following the Fukushima crisis, a high percentage of Weibos about iodized salt were deleted. That could be seen as the government’s attempt to make sure people weren’t spreading gossip and inaccurate public health information, but in the U.S. and other Western-style democracies, public health officials simply put out press releases to combat the rumors; they didn’t resort to censorship.

In days past, totalitarian governments suppressed dissent by controlling printing presses, photocopy machines, radio transmitters—devices that were expensive, difficult to transport or required special skills to operate. Wireless mobile devices are pervasive and social media is easy to use, which makes trying to control microblogging much like trying to stop the ocean’s tides.

Yet technology is a double-edged sword. While millions of microbloggers are harder to shut down than a single printing press, digital fingerprints are also easily traceable, O’Connor points out. Sina has added its own new layer of monitoring; it now forces users to register with a real name, and a “demerit” system allows customers who send out “false” Weibos to be put on warning or blocked. Both the ease of tracking Weibos and the real-name requirement could be expected to have chilling effects on speech.

As the authors point out, not every Weibo about Falun Gong or Tibet is removed, as would happen under an automatic blacklist. That suggests that human censors are in large part responsible for deciding which Weibos to remove. “I think it might reflect the tension inherent in Sina’s role,” Bamman says. “It has two different groups of people to satisfy. It’s got to satisfy the censors, but it also has to satisfy 365 million users.”

What censors allowed to remain on Sina Weibo may say as much about the political climate as what those censors deleted. “It has the potential to expose what the Chinese government thinks is sensitive at a level we didn’t have before,” Bamman says. During the Soviet era, so-called Kremlinologists studied photos of parades to deduce which Russian leaders were out of favor. Like the Kremlin, China’s political leadership makes decisions in secret, without public deliberation. Instead of subjective analysis of artifacts such as photos, students of present-day China might be able to understand the political process better through statistical analysis of social media such as Sina Weibo. —Jason Togyer (DC ’96) is editor of The Link.
Eyes (and fingers) on the road

By Ken Chiacchia

The accident didn't just seem to happen in slow motion. The elderly driver came at me across the crowded parking lot so slowly I could count the dents in the grill of his big, torpedo-nosed car. Sandwiched between a bus and another car, I had no place to go and nothing to do but lean on my horn.

In agonizing languidness, I watched him plow into my Civic. Based on his confusion after the crash, he probably should have stopped driving years before. But I can sympathize with his failure to do so. Seniors who can't drive face social isolation and difficulties in acquiring medical care and increasingly must rely on friends, relatives and formal support systems.

SeungJun Kim, a systems scientist at Carnegie Mellon's Human-Computer Interaction Institute, wants to keep seniors on the road—safely. Much of his work has focused on helping seniors interact with their cars in a way that helps them overcome the cognitive and sensory declines of aging.

Recent press coverage has centered on Kim's work on the role played by GPS displays in distracting and confusing drivers, particularly older drivers. Along with Kevin Li of AT&T and his colleagues, Kim has developed a so-called "haptic" steering wheel that tries to overcome the confusion by giving drivers tactile, physical cues as to which way they should turn. The wheel vibrates to warn a driver when he or she is veering into trouble.

"Haptic" comes from an ancient Greek word "haptikos," meaning "I touch." Haptic communication, for instance, refers to any non-verbal communication transmitted through the sense of touch—kissing, hugging, shaking hands. Haptic technologies are those that transmit information through forces, vibrations and other sensations delivered to the hands.

Haptic steering wheels themselves aren't new. Racing video games use them; so do some luxury automakers as part of early-warning systems that vibrate the wheel to tell drivers when they're traveling off the road. But what Kim and the other investigators have done—actually guiding the movements of the drivers—hadn't been tried before.

The researchers studied 33 volunteers—16 people between ages 19 and 36, 17 people between 65 and 91—in a driving simulator that offered GPS-style navigation instructions along with simulated obstacles such as unexpected pedestrians in the road. The researchers varied the visual, auditory and haptic-wheel cues to see what combinations worked best for younger and older drivers, measuring their reactions by monitoring their eye movements, heart rate and galvanic skin response.

They found that the haptic wheel improved performance by all drivers, reducing accidents and keeping them focused. The group presented their results at the Pervasive 2012 conference in Newcastle, U.K., in June.

"Younger drivers preferred visual plus auditory" input, Kim says—in other words, they liked the usual GPS format of a map display plus a voice saying when a turn is coming up or must be made. Older drivers preferred the combination of GPS-style commands and maps plus guidance from the haptic steering wheel.

But—surprise—the combinations that drivers preferred were actually the worst ones for them.

Though they didn't particularly like the haptic wheel, younger drivers actually did better with the full combination of visual, auditory and haptic feedback. By contrast, though older drivers liked the visual maps, the maps in fact appeared to distract them—and giving them only auditory and haptic feedback helped reduce the amount of forethought they needed and improved the safety of their driving.

Kim speaks of "cognitive distance"—the gap between the "physical space" (in other words, the real world) and the "virtual information spaces" we must correlate with it. While understanding a two-dimensional map seems simple, it actually takes a measurable amount of time and brain power to translate the information into three dimensions. The process of aging affects both the amount of time it takes us to read a map—reflecting "spacial cognition"—and our ability to divide our attention between the map and the road.

With colleagues at Carnegie Mellon and the Neowiz Lab in Korea, Kim has studied what factors make car dashboard displays easier and quicker to understand for both older
and younger drivers. They soon found that in-dash displays, such as those built into more expensive cars, are the most difficult to manage because they’re too far away from the windshield, requiring drivers to spend too much time with their eyes off the road.

Kim and Anind K. Dey, an associate professor at CMU’s Human-Computer Interaction Institute, wondered if a so-called “augmented reality,” or “AR,” display, combining real and virtual images projected on the inside of the windshield, might be better. They created a 3D-virtual driving simulator, something like a video game, that could display either a mixed realistic road view with a cartoon-like “GPS” map, or a more traditional combination of windshield and dashboard-mounted display. They tested the two systems on 12 seniors 65 and older, and 12 younger drivers between 19 and 41.

The AR display improved the seniors’ performance measurably, reducing their missed turns and pedestrian accidents each by more than 50 percent. While the younger drivers didn’t show a significant difference in performance between the AR and traditional displays, tracking their eye movements showed that they were less distracted by the AR display.

Kim’s work has introduced a new, useful concept to the field of driver interfaces, says Ian Oakley, an assistant professor at the University of Madeira in Portugal and an adjunct assistant professor at CMU’s HCI Institute. Oakley’s own expertise is in haptic feedback for user interfaces.

“The AR display improved the seniors’ performance,” Oakley says. “I think [Kim’s work] is a really neat, very appropriate way of intervening: putting the feedback inside the actual controls,” and so making the feedback more instantly intuitive. “I think that’s one of the main contributions here.”

Jesse Hoey, an assistant professor at the University of Waterloo, Ontario, comes to the same conclusion, but from a different perspective: he uses computer vision and artificial intelligence to create adaptive technologies for Alzheimer’s disease.

“One of the most important things in helping elderly people as they age ... is to help people stay mobile,” Hoey says. “This turns out to be very important for [their] well-being.”

“One of the slightly controversial aspects [of Kim’s work] is that the tests that they’ve been doing are all on a simulator,” he adds. “[Some] people might say, ‘All you’ve done is shown your haptic feedback works on this kind of simulator.’ Although this is true in the long run, you have to start somewhere.” He feels that the work is a necessary first step before moving to road tests, “which is likely to be an expensive thing to do.”

Testing is important to verify the results, Oakley says, because so much of the work depends on a concept of information overload that has come into question from some quarters. The idea is that “using multiple sensory channels can transmit more information to a person without an increase in overload,” he says. “But these are theories rather than facts ... and recent results indicate they may not be entirely accurate ... ‘There are central-processing limits to attention.’ But he does think Kim’s work will find practical application.

“I think this technology is a help ... situational awareness has to be focused and immediate. It’s really about removing irrelevant information.”

—Ken Chiacchia is a Butler County, Pa.-based science and technology writer who is a member of both the National Association of Science Writers and the Science Fiction and Fantasy Writers of America.
Letters to Randy Pausch

Five years ago, as Randy Pausch’s “last lecture” spread around the world via email, social media and news broadcasts, tributes poured into his office at CMU. By early 2008, Pausch, a professor of computer science, human-computer interaction and design, reported receiving more than 6,000 emails from people who said his lecture had (in his words) inspired them to “stop feeling sorry for themselves.”

By Jason Togner

Thousands of people also sent cards, letters and packages to Pausch (CS’88) in the months before his death from pancreatic cancer on July 25, 2008. They came from at least 40 U.S. states, five Canadian provinces, and every continent except Antarctica. Some people weren’t even sure how to spell his name—letters arrived at CMU addressed to Randy “Rausch” or “Pouch” or “Lausch.”

Many suggested can’t-fail miracle cures for Pausch’s terminal illness, ranging from “Essaic tea” to high-frequency radio waves. A prison inmate in California, who described himself as chairman of the “Christ for President” committee, told Pausch to consume plankton. “Eat what whales eat and live forever,” he promised. Others tried to convert Pausch to their religion and sent texts or tracts. A lady in Gilbert, S.C., was begging “on my knees” for Pausch to call her church’s pastor.

A few letters were just inappropriate. Some, perhaps not understanding the gravity of Pausch’s illness, asked for his help launching businesses. A lady from Gettysburg, Pa., criticized Pausch because she’d seen him show photos of his oldest children, Logan and Dylan, but not his youngest, Chloe, “and it just broke my heart,” she said. (For the record, the lady was wrong.)

But those were a minority. Cleah Schlueter, project coordinator for the Alice team, has carefully saved more than 500 of those letters and cards. In some cases, people seemed to be writing to Pausch to express emotions about loved ones who had died unexpectedly. They hadn’t been able to tell their loved ones they loved them, so they were using Pausch as a surrogate. In other cases, people were writing to thank Pausch for sharing his story. People in Celebration, Fla., and Lancaster, Pa., offered the Pausches free living space. The owner of a chicken restaurant in Virginia sent the Pausches 10 gift certificates for meals. Books, toys, jewelry and blankets were sent for the Pausch children. (Practically all of the gifts were donated to Pittsburgh-area charities.)

Most were simply moved by Pausch’s courage and his message, which was turned into the best-selling book, The Last Lecture, with help from Jeffrey Zaslow (DC’80). “Your book has given me new insight, and I thank you for that,” said a woman in Wappinger Hills, N.Y., whose son was struggling with mental illness. “Your love story does my heart good,” said a man in Garland, Texas, who had seen Pausch and his wife, Jai, on television.

Students were especially moved by Pausch’s message. More than one wrote to Pausch that they planned to pursue computer science careers after watching his “last lecture” online. A 12th grader in Los Altos, Calif., whose best friend was dying from cancer wrote that she looked to the Pausches for inspiration whenever it seemed too difficult to carry on. In Hsinchu, Taiwan, language students at the National Experimental High School watched Pausch’s “last lecture” and his time management lecture and then wrote essays about them, in English and Mandarin, which they bound into a book and sent to him. “You will always be here in my heart, and please, never give up,” an eighth-grader named Demi wrote.

Pausch read many of the letters, and even answered some of them, until his worsening illness prevented him from continuing, Schlueter says. The Last Lecture remained on the New York Times bestseller list for 80 weeks. (Tragically, Pausch’s collaborator, Zaslow, died in a car accident Feb. 10, 2012 in Michigan. He was 53.) As of September 2012, the lecture itself has been viewed 15 million times on YouTube, and downloaded by millions of others from iTunes and other file-sharing sites.
EXCERPT FROM LETTERS

“Students ... and I came to know you through your online lectures ‘Last Lecture’ and ‘Time Management’ last December, and have been following on your latest updates, revering your tenacity and rooting for you in our hearts every day.

“To be able to learn such valuable lessons on life and time management at such a young age, our students acknowledged that they’re in debt to you ...

“Whatever difference these promising youths will make in the world tomorrow, you have painted a bold and bright-colored stroke in their horizon today, emboldening them to bravely take on the toughest challenges with great wisdom and tenacity.”

— a teacher at the National Experimental High School in Hsinchu, Taiwan, who enclosed a booklet of letters her students had written to Pausch
Put to the test

CMU researchers have gone a long way to create a new software certification—7,670 miles to be exact.

By Jason Togyer

An athlete can train to run a five-minute mile, says Phil Miller, but the ultimate test is running a mile in five minutes, “and there’s really no way to fake it.”

The same thing applies to airplane pilots, says Miller, a project scientist at the School of Computer Science and a co-founder of distance-learning pioneer iCarnegie. Testing a potential pilot on a simulator may demonstrate mastery of certain skills, he says, but until they’ve successfully taken off in a plane, flown it and landed it safely, they don’t get a pilot’s license.

While software development holds less immediate potential for danger than flying a plane, hiring a software developer does cost money, and companies that recruit large numbers of entry-level developers need to know they can actually produce code. They’re not getting that assurance from current software certification programs, argues Miller, who’s been involved in IT workforce training for more than a quarter-century, including development of the master’s degree program in software engineering management offered jointly by SCS, the Heinz College and the Software Engineering Institute. Miller also chaired the committee that created the College Board’s Advanced Placement Computer Science offering.

At best, Miller says, existing certifications are rough assessments of ability. At worst, “someone can pass them and not be able to write software,” he says. “Companies don’t use them.”

To create a more authentic certification—one that has developers actually demonstrating their ability to write software on deadline—Miller is going all the way to Kenya. With funding from the World Bank, that East African nation is sponsoring the creation of a new software developer certification program that Kenya’s scientific and business leaders think will help market the country as a hub for information technology. The project has been named “Chipuka,” the Swahili word meaning “emerge” or “spring forth.” Kenya’s partners are Miller and other CMU researchers, including SCS Dean Randy Bryant; Roger Dannenberg, professor of computer science; Robert Seacord, who leads SEI’s secure coding initiative; Jefferson Welch, SEI’s manager of professional certifications; Marsha Pomeroy-Huff and Mary Ellen Rich, also of the SEI certification team; and SCS staffers Chad Dougherty and Bill Reier.

The Kenyan partnership with CMU was something of a lucky break. Miller was already looking for help creating a new international certification in software development. Kenyan officials were marketing the country as a software development destination, but finding few takers; companies said they had no proof that IT grads from Kenyan universities were ready for the international workforce. Mutual contacts at international development agencies connected Kenya’s Information & Communications Technology Board with Miller and CMU.

“Kenya’s ambitions with this project are to be the leading software development center in Africa and a significant global software player by engaging our latent intellectual capital,” Paul Kukubo, CEO of the Kenya ICT Board, said earlier this year. Software engineering holds “great promise for our economy,” Kukubo said, “hence our choice to invest in certifying our youth.”

But a test that certifies only Kenyan software developers is no test at all, Miller says, any more than a foot race with only one runner is really a race. “Kenya is trying to get into a competition where the eyes of the world are focused on the results, and it plans on winning,” he says. “If only Kenya is in the competition, it’s a waste of time. If this was to have been a Kenyan exam, or an East African exam or even a sub-Saharan Africa exam, the Kenyans would have spent their money poorly.”

On the other hand, if the certification is accepted by multinational software companies, “they will have spent their money wisely,” Miller says.

Kenya has every intention of seeing Chipuka develop an international standard for software development certification. “We want to lead from the front and be the technology partner of choice on the African continent,” said Bitange Ndemo, permanent secretary of the Kenyan Ministry of Information and Communication.

Kenya’s capital city, Nairobi, has long been a center for international trade and finance, and the nation’s gross domestic product of $72 billion U.S. is the largest in East Africa. Despite that, Kenya has struggled over the past decade. On several occasions, the International Monetary
Fund and the World Bank have denied loans to Kenya, alleging high-level corruption and graft. In 2007, political unrest following a disputed national election turned into two months of sporadic violence in which 1,500 people were killed. Kenya’s economy is mostly driven by agriculture and tourism, leaving the country vulnerable to droughts and oil price fluctuations; according to one estimate, Kenya’s unemployment rate is near 40 percent.

In an attempt to change the country’s direction, Kenya has invested heavily in education. In 2005, Kenya began a national system of school assessments to monitor educational progress. The country now spends about 7 percent of its GDP on education, more than all but 10 or 20 nations, and its literacy rate, though lower than those of North America and Europe, is among the highest in Africa. About 60 percent of Kenyans who complete secondary school attend one of the nation’s seven public or 23 private universities.

It would be “presumptuous,” Miller says, for him to try and evaluate the quality of Kenya’s universities. “There is a tradition of higher education which includes computer science education, and it seems recognizably good,” he says. “I would not be at all surprised that the typical test-taker from Kenya ends up performing quite well” on traditional IT certification tests.

The problem is not necessarily with the test-takers, but the tests. One popular, ISO-accredited software certification quizzes developers on 25 different areas, Miller says. “They ask questions, rather than have you practice them,” he says. “They ask some questions about software requirements, for instance, which is nice, but it would be more authentic if people actually had to gather and manage and otherwise deal with requirements.” Someone with proper training in software development should do well on such an exam, Miller says, but it’s “at least a couple of orders of magnitude” away from actually writing software.
To develop an authentic test, Miller and his team spent more than three months interviewing more than 100 software developers in Kenya, India and the U.S. asking them such questions as which languages do you use? What data structures and algorithms have you worked with? What’s your day-to-day workflow? From this role delineation study, the Chipuka team developed a list of typical tasks that an entry-level software developer should be able to perform. That list forms the heart of a questionnaire, and a large sample of professional developers will be surveyed in a formal job task analysis.

After the initial interviews, the Chipuka team developed a “pre-pilot” test to offer to software developers already working in their field. “That way, we can get some good data and see what are the tasks that actually discriminate between different skill levels, and what are the ones that are impossible for everybody,” Miller says. The first pre-pilot exam was done in Nairobi on Aug. 28, when 10 highly regarded young software developers and advanced university students worked on six different tasks. Results ranged from one student who was unable to correctly write any tasks to others who went well beyond what Miller’s team expected. Reactions to the test were “uniformly positive,” Miller says, with test-takers reporting that they liked working on real problems, and the fact that they had time to prepare for the exam.

A pilot exam is expected to take place in April 2013, with the full certification program up and running in Kenya by October 2013. Exam takers will be expected to prepare beforehand by downloading the code base and development tools and familiarizing themselves with the specifications. Miller envisions an exam taking about six hours (“I don’t think you really ought to plan a lot of other things for that day,” he says) in which a developer has to take an existing piece of software and add a new feature. For instance, one pre-pilot exam required users to write a program to read and write comma-separated values to a spreadsheet.

There’s no timetable yet for when Chipuka might go international. To gather real-world problems and build trust, the Chipuka team is leaning heavily on collaboration with developers in the open-source software community. “I believe if what we’re doing is successful, we will set a standard,” Miller says. “It’s a really different philosophy. Typically, in an examination, people spend a lot of resources hiding things. We’re spending a lot of resources not only exposing them, but trying to get people to check them out.”

Jason Togyer (DC’96) is editor of The Link.
Motorists struggle to see when they’re driving at night in rain or snow. But a smart headlight system invented by researchers at the Robotics Institute might be able to improve visibility by constantly redirecting light to shine between particles of precipitation.

The system, already demonstrated in laboratory tests, prevents the distracting and dangerous glare that occurs when headlight beams are reflected back toward the driver by precipitation.

“If you’re driving in a thunderstorm, the smart headlights will make it seem like it’s a drizzle,” said Srinivasa Narasimhan, associate professor of robotics.

The system replaces conventional halogen lamps with a digital light projector, or DLP, then uses a camera to track the motion of raindrops and snowflakes. It applies a computer algorithm to predict where those particles will be, and deactivates light beams that would otherwise illuminate the particles in their predicted positions.

“A human eye will not be able to see that flicker of the headlights,” Narasimhan said. “And because the precipitation particles aren’t being illuminated, the driver won’t see the rain or snow either.”

To people, rain can appear as elongated streaks that seem to fill the air. To high-speed cameras, however, rain consists of sparsely spaced, discrete drops. That leaves plenty of space between the drops where light can be effectively distributed if the system can respond rapidly, Narasimhan said.

In lab tests, Narasimhan and his research team demonstrated that their system could detect raindrops, predict their movement and adjust a light projector accordingly in 13 milliseconds. At low speeds, such a system could eliminate 70 to 80 percent of visible rain during a heavy storm, while losing only 5 or 6 percent of the light from the headlamp.

To operate at highway speeds and to work effectively in snow and hail, the system’s response will need to be reduced to just a few milliseconds, Narasimhan said. The lab tests have demonstrated the feasibility of the system, however, and the researchers are confident that the speed of the system can be boosted.

Rather than using DLP technology, Narasimhan said, a roadworthy system would probably deploy arrays of light-emitting diodes in which individual elements could be turned on or off, depending on the location of raindrops. New LED technology could make it possible to combine LED light sources with image sensors on a single chip, enabling high-speed operation at low cost.

Narasimhan’s team is now engineering a more compact version of the smart headlight that in coming years could be installed in a car for road testing.

Though a smart headlight system will never be able to eliminate all precipitation from the driver’s field of view, simply reducing the amount of reflection and distortion caused by precipitation can substantially improve visibility and reduce driver distraction. Another benefit is that the system also can detect oncoming cars and direct the headlight beams away from the eyes of those drivers, eliminating the need to shift from high to low beams.

“One good thing is that the system will not fail in a catastrophic way,” Narasimhan said. “If it fails, it is just a normal headlight.”

The team’s research was sponsored by the Office of Naval Research, the National Science Foundation, the Samsung Advanced Institute of Technology and Intel Corp. Collaborators included Takeo Kanade, professor of computer science and robotics; Anthony Rowe, assistant research professor of electrical and computer engineering; Robert Tamburo, Robotics Institute project scientist; Peter Barnum, a former robotics Ph.D. student now with Texas Instruments; and Raoul de Charette, a visiting Ph.D. student from Mines ParisTech, France.

—Veteran science journalist Byron Spice is director of public relations for the School of Computer Science.
In July 2012, Luis von Ahn was named a recipient of the Presidential Early Career Award for Scientists and Engineers, the highest honor bestowed by the United States government on science and engineering professionals in the early stages of their independent research careers.

Von Ahn, 33, is the A. Nico Habermann Associate Professor of Computer Science at Carnegie Mellon. He was one of 96 PECASE recipients announced by the White House and was one of 20 recipients nominated by the National Science Foundation.

A native of Guatemala, von Ahn is a graduate of Duke University who earned his Ph.D. in computer science at CMU in 2005, where his advisor was Manuel Blum.

Von Ahn's past awards include a MacArthur Fellowship in 2006, a Packard Fellowship and Sloan Research Fellowship in 2009, and the Association for Computing Machinery's Grace Murray Hopper Award earlier in 2012. Last year, Spanish Foreign Policy magazine named him the most influential new thought leader of Latin America and Spain.

He spoke with Link Editor Jason Togyer.

How did you get started in computers?

I was 8 years old and I wanted a Nintendo, but my mother bought me a Commodore 64 instead. I had no idea how to use it, but I had to figure out some very basic programming in order to run some games. I started getting better mainly because my mom wouldn’t buy me many games, and I had to figure out how to break the copy protection they had. So I guess I got started by pirating games!

What convinced you that this was a field you wanted to work in?

I actually majored in math in college, but one thing I didn’t like about math was that when I visited grad schools, the profs would tell me things like, “I’ve been working on this problem, and no one has solved it in 300 years.” Whereas in computer science, people were like, “I solved an open problem yesterday and I’m working on another one.” It was a much more vibrant field, mainly because it’s only been around for 50 years instead of 2,000 years. There’s still a lot left to do.

Your work here with Manuel Blum is what led to the original Captcha. Are you surprised at how ubiquitous it’s become?

Yes, I didn’t expect that—it’s literally used by every major website in the world. The first Captcha that I wrote for Yahoo! was not meant to be used by more than 100,000 people. It was kind of a toy. Now, about 250 million times a day, someone types a Captcha.

Would that be a bad thing to be remembered for?

Probably not, though I find the other research that I’ve done to be more exciting.

You’ve referred to “games with a purpose.” What are games with a purpose?

I started working on “crowdsourcing” in 2001. At the time, that word didn’t exist—it was just “well, there’s the web and we’re trying to get people to help us do some stuff.”

I developed a game called the ESP Game, which was played by a few million people, and as people were playing it they were helping us improve image searches. It was one of the first examples of a game that was used for scientific purposes. Then it occurred to me that I could combine these games with crowdsourcing, which is where the idea for ReCaptcha came about. I think ReCaptcha is the crowdsourcing idea that’s been used by the largest number of people on the planet. About 1 billion people have helped digitize books with ReCaptcha, which is several orders magnitude bigger than anything else.
Do the people who are typing these ReCaptchas realize they're digitizing books?

No. Although we don’t try to hide it at all, in many cases they don’t know why they’re typing these squiggly characters. The key to making these things work is making them a part of what people would do anyway. Similarly, with “games with a purpose,” we’re kind of getting something for nothing.

What makes a compelling game?

It’s a complete art. It’s very similar to making a good movie. You can have the right actors and the right director and in the end, it flops. And it’s not just games—it’s what makes a compelling user experience. This new project that we’re working on, Duolingo, is not a game, but we’ve spent a lot of effort trying to make it more and more compelling.

Give me the elevator pitch for Duolingo.

Duolingo began when we asked the question, “How can we get 100 million people to translate the web into every major language?” Google Translate is getting better, but it’s crude. If I really want to translate the whole web accurately, I literally need millions of people. And—I can’t pay them. If that’s how you start, you quickly run into some major obstacles.

Such as?

First, a lack of bilingual people. There just aren’t that many. Second, how are you going to motivate people to translate for free? It’s normally something you have to pay professional translators about 10 cents a word to do. We were stuck on this problem for a while until we figured out there’s a way to solve both of these problems with one solution. It turns out there are about a billion people in the world who want to learn a foreign language right now. So we came up with Duolingo, a language-learning site where you learn for free, but the twist is that you learn by translating real-world sentences.

How does it work?

When you first show up, if you’re just a beginner, we give you very simple sentences to translate, and we tell you what each word means. As you do more, you get more and more complex sentences. The crazy thing is that it really, really works—people really do learn another language. Instead of paying with money, the student pays with time. As they’re learning they’re also creating value with these translations. It’s time that would need to be spent anyway. That’s nice. I like that.

Where do the texts come from?

Basically, we’re crawling the web for Creative Commons stuff. If you want your stuff translated, sure, we’ll do it, but you’ve got to upload it. We don’t want to get sued for stealing your content.

Have any major publishers signed up?

Yeah, but I can’t talk about it yet. Some of the largest publishers in the world are very interested. Translation is huge, it’s about a $30 billion market, but it turns out that only about 0.1 percent of what needs to be translated actually gets translated. The other 99.9 percent isn’t worth 10 cents a word. News is an example—most news outlets are not doing all that great, and they can’t afford 10 cents a word. Those are exactly the kinds of stories we want to be translating.

Do those kinds of articles work for someone who’s learning a language?

They’re super-interesting if you’re learning a language! Instead of translating, “the girl jumps, the girl eats, the boy jumps, the boy eats,” now you’re learning a language by reading something that actually has a thread. I’m very excited about it.

Where would you like to see Duolingo in a couple of years?

I’d like it to be the language learning standard, and I think we can do that. It’s free and it’s really good. And because of that, I want to be able to be translating at a high rate. Translating a million articles a month, something like that.

What’s next?

Duolingo. That’s it. There’s one big difference between me and most people. They have 10 projects. I have one. When I started working on my Ph.D., I tried working on 10 different projects, and I ended up with 10 (lousy) projects.

What would be your career advice to someone who’s 13 or 14?

Use a computer! The earlier you learn how to use a computer, the better. The kids that we’re seeing as undergrads here started learning how to use a computer way earlier than I did. It’s as if I started learning French at age 8, where they started learning at age 4. They’re much better. If you want to be part of the future, you should be using a computer. I understand there are cases of addictive behavior, but otherwise I would hope that kids are using a computer as much as they can—▲
It’s the first fall semester in SCS history without Mark Stehlik advising and teaching undergraduates on the Pittsburgh campus. As Stehlik starts his new post in Qatar, alumni share some favorite stories.
By Meghan Holohan

“I knew I wanted to teach when I was in second grade,” Mark Stehlik says.

That’s when Stehlik set up an easel blackboard in the garage of his parents’ house in Queens, New York. Every day after school, he patiently taught English to his neighbor, Carlos. For several months, Stehlik sounded out English words and introduced the basics of grammar to Carlos Ramirez, who had moved with his family to the United States from Costa Rica. After completing a few exercises, the two would chat so Carlos could bolster his conversational skills.

Carlos returned to Costa Rica and now works as an architect, but Stehlik’s love of teaching has never waned.

Since 1982, Stehlik has been teaching computer science at Carnegie Mellon University. And he’s served as an assistant dean and undergraduate advisor, helping more than 2,500 students, since 1988. On April 25, Stehlik received CMU’s Robert E. Doherty Award for Sustained Contributions to Excellence in Education. (Past recipients have included such CMU faculty icons as former Dietrich College Dean Erwin Steinberg, longtime physics instructor Hugh Young and Angel Jordan, emeritus University Professor of Electrical & Computer Engineering and Robotics.)

But after 30 years of working in computer science education at CMU’s Pittsburgh campus, Stehlik is making a major change—he’s gone to CMU’s Doha, Qatar campus, where he has begun a five-year appointment as associate dean of education.

“All I’ve done is care about the students who come through this door,” he says.

Colleagues say he sells himself short. “Mark has been the heart and soul of our very successful undergraduate program since its inception in 1988,” says Randy Bryant, university professor and dean of the School of Computer Science. “Mark sets a standard of excellence as an educator that makes the rest of us try harder. His concern for the students, both in terms of their educational experience and their personal lives, makes us all do our jobs better.”

As a high school student at St. Francis Prep in Queens, N.Y., Stehlik took a FORTRAN programming course, punching his programs into paper tape, feeding them into a reader and sending them over a 300-baud modem to a mainframe on Wall Street for processing. That experience gave him a lifelong love of programming, and combined with a love of math sparked by a sixth-grade teacher, inspired him to major in math and computer science at New York’s Pace University.

As he neared graduation from Pace, an advisor suggested that Stehlik pursue a Ph.D. in computer science, so he applied to CMU, Stanford University, Massachusetts Institute of Technology and New York University. When CMU accepted him, his advisor urged Stehlik to take the offer, saying, “You got into Carnegie Mellon, you have to go there!”

But after two years in the Ph.D. program, Stehlik realized that he was increasingly unhappy doing research. When his advisor, Jon Bentley, left CMU for Bell Labs and a position as a computer science lecturer opened up, Stehlik asked if he could try teaching instead. The department gave Stehlik a semester to prove himself. It was all that he needed.

When students evaluated their professors and classes at the end of the semester, Stehlik had the highest scores of any faculty member, and Stehlik realized he loved teaching as much as he
did when he taught English in his parents' garage. When a permanent position became available, Stehlik abandoned his Ph.D. and turned his full attention to teaching, including many of the department's 100-level courses in Pascal, C, C++, Java and Python. In 1993, Stehlik was given Carnegie Mellon's award for Outstanding Contributions to Academic Advising and Mentoring, and in 1997, he received SCS's Herbert A. Simon Award for Teaching Excellence.

Stehlik's impact has been widely felt, not just in SCS but also in other departments. About 900 students take 100-level classes in computer science every semester, Bryant says, and a majority of CMU undergraduates take at least one SCS course during their academic career. “Mark has also consistently been part of the teams that devise new introductory courses,” Bryant says.

And while Stehlik describes himself simply as a teacher, his impact on computer science education has been felt far beyond Carnegie Mellon. In 2010, he co-authored “Running on Empty: The Failure to Teach K-12 Computer Science in the Digital Age,” a report examining the fragile state of computer science education in the United States. He also co-authored Karel++: A Gentle Introduction to the Art of Object-Oriented Programming; Karel the Robot: A Gentle Introduction to the Art of Programming; and an early teacher's guide to advanced placement computer science. Stehlik has trained hundreds of high school teachers for Advanced Placement, or AP, courses in computer science since they were first developed in 1984. He also served as the chief reader for the AP exams in computer science, supervising the grading of 15,000 AP exams over the course of a week.

Jim Roberts, a former faculty colleague in Computer Science and now an adjunct instructor in CMU’s College of Fine Arts, has taught many courses with Stehlik over the years, and co-authored the Karel books with him. “We wanted to have fun teaching,” he says. “We felt if the students didn’t have fun, we wouldn’t have fun. We’d plan the next assignment based on the last. If the last was too easy, we’d structure a harder one. If it was too hard, we’d reinforce the (basics).”

Roberts fondly recalls the two of them playing pranks on each other and occasionally getting into heated debates with Stehlik during class, which he says helped to engage students in the lessons. “We tried to challenge the students and each other while we were teaching,” Roberts says.

At a going-away party for Stehlik, David Kosbie, assistant professor of computer science and this year’s SCS Simon Award winner, said Stehlik’s example made him a better teacher. Kosbie said that when he first began teaching, it didn’t go well. As he wondered how he could improve, he stumbled upon the obvious solution.

“One thing I kept telling my students was, ‘Find a mentor and model him,’” Kosbie said. “And so this is exactly what I did. And the best educator I know is Mark, so I went to the
“One thing I kept telling my students was, ‘Find a mentor and model him,’” Kosbie said. “And so this is exactly what I did. And the best educator I know is Mark, so I went to the school of Mark, and tried to be just like Mark. And guess what? It actually worked.”
When necessary, Stehlik was willing to go the extra mile for students—or in one case, 400 miles. In September 2004, four CS majors were involved in a car accident in Sandusky, Ohio. Their car was totaled. Unable to get home, they called Stehlik. At 11 p.m. He drove to Sandusky, picked them up, made sure they were OK, brought them back to Pittsburgh, got home at 5 a.m. and was in his office later that same morning.

Andersen says Stehlik had a knack for understanding where each player was in her development, and encouraging her to accomplish what she could. Andersen recalls Stehlik celebrating when a young student hit the ball over the net for the first time just as much as when a skilled player made a great save. (Kristin Stehlik is now 24. Stehlik also has a son, Matthew, 28, who grew up playing volleyball on the mall, and a stepson, Damian, 38.)

“He was always looking for ways to help people learn and grow in ways that you can succeed,” Andersen says. “He would push you further than you thought you could go, but not further than you could go.”

When necessary, Stehlik was willing to go the extra mile for students—or in one case, 400 miles. In September 2004, four CS majors were involved in a car accident in Sandusky, Ohio. Their car was totaled. Unable to get home, they called Stehlik. At 11 p.m. He drove to Sandusky, picked them up, made sure they were OK, brought them back to Pittsburgh, got home at 5 a.m. and was in his office later that same morning.

Some journeys were more figurative than literal. In the fall of his senior year, Nathaniel Manista (CS’02, S’02) decided he wanted to graduate both with the physics degree he’d already been pursuing as well as with a computer science degree. To do it, he would need to stay at CMU an additional year and finish all of the CS major requirements in three semesters.

Stehlik didn’t discourage Manista, but he also pulled no punches. “He made it clear what kind of performance would be expected, what I was getting into, and what kind of attitude that I would need to succeed,” Manista says. “I was an atypical, non-traditional student,” he says, adding that Stehlik warned him, “You are sort of on your own.”

But Manista wasn’t on his own. In addition to guiding Manista through his fifth year as a CMU undergraduate and the immersion into a completely new program, Stehlik served as the instructor for a special 3-unit independent study class which Manista took during his last semester. Despite taking a heavy load of CS classes, a quirk in the way that courses were weighted left Manista just shy of the full-time minimum, so Stehlik created a 3-unit course in … darts. Once a week, the “class” met at Stehlik’s home, where the two played darts and talked about organizational politics and management. Manista also gained insight into Stehlik.

“One of the greatest privileges of my friendship with Mark has been having a very unique and valuable view into his thoughts and feelings on what it is like to be in service to hundreds of students,” Manista says. “I feel like I get to see what not many others get to see—what he finds rewarding and what he finds to be a struggle.” (Manista says he was able to get the better of Stehlik about 20 percent of the time. Although there was no doubt about Manista’s final grade, his “final exam” score was determined by the sum of five darts. As Stehlik remembers, Manista’s first dart was a triple-20.)

After graduation, Manista continued visiting Stehlik’s home to throw darts. As the friendship grew between the two, Manista began bringing his girlfriend, Krista, to cheer for him. When he proposed to her and the two began planning the wedding, Manista needed to pick a best man, and decided on Stehlik. He also served as their chauffeur after the ceremony and took the opportunity of being alone with the newlyweds to impart some words of marital wisdom.

“He gave us some really great advice, thoughts and commandments,” Manista says. “Krista and I still repeat to each other things he told us. Usually during the good times, sometimes during the fights, and in general, not often enough.”

At times, Stehlik has stepped up for people he didn’t even know. During her freshman year, Natalie Morris (CS’12) was sitting on a beanbag chair near Stehlik’s office, crying, when he approached her with a box of tissues. He wasn’t her advisor or teacher at the time, but she needed help, so he took the time to find out what was wrong, she says.

“He advises anyone who needs it, even if he’s not officially your advisor,” Morris says, joking that she eventually learned that Stehlik “could solve any problem.”

Stehlik did become Morris’ official advisor during the last three years of her college career, and besides approving
her classes (and letting her vent), he took an interest in her professional goals. “Officially, you have to have one meeting per semester with your advisor,” Morris says. “Mark has an open door policy, which is pretty atypical.”

When a company was on campus that Stehlik thought Morris would be interested in, he made sure to point it out. “He knew that I was interested in aerospace as a possible career,” Morris says. “If he knows you’re interested in a particular company or career path, he’ll send you special emails when that recruiter will be here.”

In the fall of her junior year, recruiters from SpaceX, the private space exploration company created by PayPal co-founder Elon Musk, visited campus, and representatives asked Stehlik to suggest students to meet them for dinner. Morris was on his list. She talked to them and a few weeks later she received an internship offer. After spring graduation, she moved to Los Angeles to start her career at SpaceX.

Stehlik gets emotional when he talks about leaving the Pittsburgh campus. He will miss hosting Thanksgiving dinner for students who were not going home for the holiday. This tradition started 21 years ago and his wife and kids still talk about students that they met along the way. One day, while taking the bus home to Carnegie, Stehlik got stuck in traffic because of rain and a Pitt basketball game and started thinking about the students who hold a special place in his heart. He had gotten to 100 before he arrived home, and only stopped because he had to turn off his computer.

But as much as Pittsburgh has meant to him, he’s also excited about the opportunities that Doha presents. As associate dean of education for CMU’s campus at Education City, Stehlik will have plenty of problems to tackle, and says his experiences working at SCS during its early years will help.

“I like to be able to chart my own path,” Stehlik says. “I’m much happier where I can solve problems and do so in a creative way.”

—Meghan Holohan is a Pittsburgh-based freelance writer whose work has appeared at Salon, MentalFloss.com and NBCNews.com.
How design practices affect results

By Steven P. Dow

In their 2001 book Art & Fear: Observations On the Perils (and Rewards) of Artmaking, David Bayles and Ted Orland share a story about a ceramics teacher who divided his class into two groups. He told one half they would be graded on quantity, so they should “produce as many ceramics you can in one quarter, that will be your grade,” while he told the other half they would be graded based on one good ceramic.

Bayles and Orland found that “while the quantity group was busily churning out piles of work—and learning from their mistakes—the quality group had sat theorizing about perfection, and in the end had little more to show for their efforts than grandiose theories and a pile of dead clay.” Iterative deliberate practice led to better results.

Iteration, or, in simpler terms, repetition, is a basic tenet of design practice. (In mathematics and computer science, iteration describes the act of solving a problem by computing a series of approximations, each building on the previous one, to achieve an accurate result.)

While the story about the ceramics class resonates with some people, others might say, “This isn’t how it works in industry where we have real time constraints. Yes, it would be wonderful to try lots of alternatives, but we simply don’t have time.” This raises a question about how design practices affect results—under time constraints, should people iterate or should they focus on refinement?

My research centers on questions about creativity and collaboration. I seek to uncover the cognitive and social factors that affect the often-messy process of design and scientific inquiry, and to investigate these issues within the modern landscape of social media, online gaming and crowdsourcing. Ultimately, I’m interested in understanding and improving how people can design better products, services and systems.

I developed these interests as a post-doc at Stanford University. Stanford has a school of design known as the “dSchool.” About five years ago, they began to teach a problem-solving process known as “design thinking.” Design thinking is an interdisciplinary method of problem solving which puts a premium on prototyping and developing empathy for the target users.

These days, when you step into the dSchool, you’ll find posters urging students to defer judgment, go for quantity, encourage “wild” ideas, build on the ideas of others, have one conversation at a time, stay focused on their topic and think “visually.” Rolling whiteboards, adjustable furniture and ongoing student projects are on display, encouraging collaboration and a free exchange of ideas. These are also signs of commitment to design thinking that say, “Believe in Process.” Often the commitment to particular problem solving strategies rests largely on faith, not on concrete, empirical evidence.

That’s where my research comes in. My colleagues and I have run a series of experiments that examine how prototyping practices affect design results.

But how can we measure creative thinking skills? Scientists have long been interested in creativity. One classic insight experiment is the nine-dot problem, invented by American psychologist Norman Maier in 1930. (Figure 1) Participants must connect nine dots with four straight lines without ever lifting the pen. The insight that participants often miss is that the lines must extend “outside the box.” (Yes, that’s where the phrase “outside-the-box thinking” originated.) The length of time it takes people to solve the problem provides a dependent measure. (Figure 2)
When we thought about how design and engineering unfold in real practice, we realized we needed a better Petri dish. Unlike the nine-dot problem, we wanted participants to demonstrate creativity. Real-world design problems have many possible solutions and many different paths to success. We also wanted to have objective and subjective criteria—we needed a good way to contrast solutions people come up with.

Our insight here was to leverage the “egg drop design” task where participants design a vessel (like the one in Figure 3) to protect a raw egg from a fall. Our dependent variable: how high can you drop the egg without the egg breaking?

In one experiment, in the spirit of the ceramics story, we explicitly examined iteration. Half of our participants were encouraged to rapidly generate new ideas for egg-drop containers; the other half focused on perfecting one design. Everyone came up with very different ideas, with varying degrees of success. (Figure 4)

The results showed quantitatively that, even under tight time constraints, people who were forced to rapidly iterate outperformed those who didn’t.

The experimental results were not particularly surprising, and confirmed the intuitions of the ceramics teacher. Most of us would expect that rapid iteration would yield benefits. But, what was really interesting is what we saw qualitatively in the participant interviews: Independent of study condition, participants tended to pick one idea and stick with it. Participants said things such as, “For some reason, (this design) seems to be the only (way). There needs to be a platform and then as good of a cushion as possible. I don't see any other way.” Or, “I kind of just had one idea and I was going to try to make it work.” Or, “I went with the whole parachute idea … I had from the beginning.”

Figure 2

Figure 3

Figure 4
Time constraints certainly contributed to participants’ limited exploration, but more interestingly, people felt they had fully explored the concepts, and they could not see any other alternatives for the materials.

In design, people often fixate on one solution without considering others. Participants in our egg-drop experiments exhibited a psychological effect known as functional fixation, first studied by German-American psychologist Karl Duncker back in the 1930s. He did a series of experiments that have come to be known as the “Candle Problem.” Duncker presented his participants with a table pushed up against a wall. The table held a candle, a box of thumbtacks and a pack of matches. Duncker then asked his participants to affix the candle to the wall so that the wax does not drip on the table. This is a challenging puzzle for most people.

The hidden insight is that the box of tacks—one emptied—can be tacked to the wall and used to hold the candle and catch the dripping wax. Participants in Duncker’s experiments often exhibited functional fixation; they viewed the box’s only function as a container for tacks. As in our egg-drop experiment, once the participants developed an initial idea, they became fixated on making that idea work, instead of exploring different ideas.

Subsequent tests of Duncker’s candle problem have showed that if the exact same materials are provided, but the tacks are left outside the box, loose on the table, people are much more likely to solve the puzzle.

Following our egg-drop experiment, we wondered, instead of just iterating solutions to a problem and soliciting feedback on each iteration, what if people created and tried different designs in parallel? (Figure 5)

To answer this empirical question, we gave participants a design task where the solutions were both creatively diverse and objectively measurable. This time, instead of egg-drop vessels, we had participants design Web advertisements for Stanford’s Ambidextrous magazine, a student-run journal of design and engineering. We were then able to place the ads online and collect objective outcome metrics—how many clicks an ad receives, compared to how many times it’s shown.

In the study, each participant created five prototypes and a final design within the same overall time period. In the Serial condition, participants received critiques on one prototype at a time. Participants in the Parallel condition created three prototypes, received critiques on all three, then made two more prototypes, and received critiques again. The critique statements were technical in nature, intended to provide high-level direction, without using explicitly positive or negative language. Importantly, the only difference between conditions was the timing of the critique.

In the end, we got lots of ads. (Figure 6) We took all 33 final participant ads and launched a 15-day ad campaign online. In total, we generated about 1 million ad appearances.

What were the results of this experiment? According to the ad campaign data, Web users clicked more Parallel ads per appearance than Serial ads. Not only did Parallel ads generate more visitors to the Ambidextrous website, those visitors spent more time on the client site, so the Parallel ads did better at reaching the target audience.

Moreover, independent expert raters—both ad professionals and the magazine editors—judged the Parallel ads to be better than Serial ads. By all measures, the “Parallel” process outperformed the serial process.

Why did we see this difference? Why does a parallel approach lead to better results?
In design, people often fixate on one solution without considering others. Participants in our egg-drop experiments exhibited a psychological effect known as functional fixation, first studied by German-American psychologist Karl Duncker back in the 1930s.

One reason has to do with our basic human ability to draw contrasts. In a 2003 study, Dedre Gentner, Jeffrey Loewenstein and Leigh Thompson compared a traditional case-based learning approach—where participants independently read and described separate case studies—to a more comparative approach. In the comparative approach, participants were explicitly prompted to describe the parallels of both solutions. They found that when prompted to explicitly draw a comparison, participants were nearly three times more likely to understand the principle behind the cases and to transfer what they learned. People do a better job of capturing the underlying structure when they compare.

Going back to our ad study, then, we can surmise that comparing critique statements on two ads side-by-side helped participants extract important graphic design principles.

The interviews provided additional context. In design, feedback is often a double-edged sword: it helps people learn, but it can also damage the ego because people tend to invest emotionally in the things they produce. Eight out of 17 participants in the Serial group reacted negatively, calling the feedback “negative.” One participant told us, “There was a short period (after each critique) where the emotional response overwhelmed any positive logical impact.”

None of the Parallel participants described the critiques as negative. Although the language in the Serial critiques was not any more negative than the Parallel critiques, it was just perceived that way. The groups who worked on ads using the Parallel approach did not emotionally invest in individual solutions; instead, they were open to multiple possible outcomes.

We then asked ourselves, “If people react this way to critiques from a random expert, how would this play out in small groups? In groups, would creating and sharing multiple designs improve the outcome, over just bringing one design?”
Turing Award winner Fred Brooks once said, “Prototypes can be more articulate than people.” Prototypes help ground communication and embody the entailments of design concepts. However, the presence of a concrete prototype may—for better or worse—focus a discussion on refining that idea, rather than thinking more broadly. Moreover, people tend to polish prototypes to look good in front of their colleagues.

Alternatively, designers may choose to share multiple prototypes at group meetings. In theory, this should help reduce fixation and give group members license to be more candid and critical of their own and other’s ideas. But generating multiple alternatives can also have adverse effects. It leaves less time to polish each idea, and increasing the number of options on the table—and the number of implications that arise from these alternatives—may complicate the decision process and jeopardize a group’s ability to achieve consensus.

We hypothesized that sharing multiple prototypes would lead to better results because people would explore more concepts and be more open to adopting and merging new ideas. Again, we had participants design Web advertisements, this time for FaceAIDS.org, a non-profit organization dedicated to fighting AIDS in Africa. Again, we could launch the ads online through Google’s ad networks and collect relative performance metrics.

We recruited 84 participants, balanced for prior experience and gender, and placed them into one of three conditions. In the “share multiple” condition, participants created three ad designs and shared all three in a group meeting with their partner, where they critiqued each other’s ideas. In the “share best” condition, participants created three ads, but then chose only one to share with their partner. In the “share one” condition, participants spent an equivalent amount of time on just one ad, and then shared that with their partner. We chose these three conditions to separate the effects of producing multiple designs from sharing multiple designs.

In all conditions, after the group meeting, each of our 84 participants went back and individually created a final ad. Some were great, some were cliché and some were very clever. These final ads were launched simultaneously in a 12-day ad campaign through Google AdWords. In total, we generated 474,539 impressions. We also had a range of experts—including the FaceAIDS clients—rate the ads on their effectiveness.

The results showed that Web users clicked more ads per appearance created by the “Share Multiple” conditions than either of the other conditions. (Figure 7) Moreover, ad experts and the clients all rated Share Multiple ads higher than the other conditions.

Again we must ask, “Why does creating and sharing multiple designs lead to better results?” Our analysis examined the literature on examples, design exploration, conceptual blending and group rapport.

For one thing, it helps to have more ideas on the table. In a 2010 study, Brian Lee, Scott Klemmer and colleagues of Stanford University’s HCI Group found that people produce better Web designs when given a gallery of examples. Examples expose people to more design features and diverse perspectives.

Were there differences in how participants in each condition explored concepts? How much did that group meeting affect the final designs? Interviews revealed that
participants in the Share Best and Share One conditions tended to stick with what they had. The Share Multiple groups took the best of multiple concepts and blended their ideas.

We quantified this notion of blending concepts by counting features that migrated from one participant’s early designs into their partner’s final design—similar kinds of images, shared phrasing and a reddish background color. It turns out that participants in the Share Multiple conditions borrowed far more features than pairs in the other conditions. (Figure 8)

One reason for this was the visibility of work. Much like a design studio, people learn by simply being able to see their peers’ ideas. It exposes people to the space of possibilities. Further, during “crits,” Share Multiple participants were less invested in a single outcome, so they did a great job of exchanging ideas, while Share One and Share Best participants tended to bottle up and sit there in silence for fear of offending their partner.

Our studies revealed a number of quantitative differences of sharing multiple designs. We concluded that better design was a function of better comparison, more individual exploration, more feature-sharing, increased in-group rapport and more conversational turns. A simple change in the process not only produced better designs, it led to more idea sharing and better overall collaboration. This research on creative process directly informs my future projects. I’m interested in how these phenomena play out in new contexts, particularly with online crowds. I have two new projects, supported by grants from the National Science Foundation, which will examine the intersection of design and crowdsourcing. The first is a collaborative effort with Bjoern Hartmann of the University of California at Berkeley that explores how group dynamics affect creative work done by online crowds. The second is a collaborative effort with Liz Gerber of Northwestern University that examines how we can bring crowdsourcing resources—such as social media, Amazon Mechanical Turk and crowd-funding—into the classroom to help inform student innovations.

Crowdsourcing techniques and web analytics provide an opportunity to do experimental research on creativity with objective outcomes. We have been able to get leverage by giving participants tasks—like Web banner ad design—where the solutions are both creatively different and objectively measurable. Our work shows that design thinking methods have measurable value in the online world, and that simple process changes can lead to better solutions.

—Steven Dow is an assistant professor of human-computer interaction at Carnegie Mellon University, where he researches human-computer interaction, creative problem solving, prototyping practices and crowdsourcing. He is a recipient of Stanford University’s Postdoctoral Research Award and co-recipient of a Hasso Plattner Design Thinking Research Grant. Dow earned both his M.S. and Ph.D. in human-centered computing at the Georgia Institute of Technology, and a B.S. in industrial engineering at the University of Iowa.
Some people think of summer as a season of long, lazy, carefree days. They view autumn as a time when the world prepares to go into hibernation for the winter—the leaves turn color, fall from the trees and die; the temperature cools; we all turn on the heat and bundle up (preferably in Tartans clothing).

But those of us on campus at Carnegie Mellon see the world differently. For us, summer is far from lazy, and autumn is a time of new beginnings and new promise.

It's true that campus is quieter during the summer. Some of our students have graduated and gone on to work or graduate school. Others have gone away for the summer, in many cases for internships, where they further their computer science learning while getting paid at the same time, working with some famous names in the computer industry and some soon-to-be-famous startup companies. They all acquire great stories and great contacts.

We were busy this summer too, seeing many of you at alumni and new student/parent events in Boston, San Diego, Seattle and the Bay Area, among others. The combined SCS/ECE alumni gatherings included boat cruises and other lovely venues, and it was fantastic to see several hundred alumni and families during these events. We were fortunate to have School of Computer Science Dean Randy Bryant and ECE Department Head Ed Schlesinger join us for these events.

Now we're back on campus, and as summer waned, campus became far more active! Students returned from their summer jobs (and other less lucrative adventures), and re-immersed themselves into campus life, classes and friendships that were carried on mostly electronically over the summer. New undergraduate and graduate students nervously made their appearance, got to know our faculty and worked out which classes they wanted to take. Most of you reading this letter will recall the feeling of excitement and buzz in the air during the first few days you spent on the Carnegie Mellon campus—whether in Pittsburgh, Doha, Silicon Valley or elsewhere.

We are looking forward to an exciting fall. We've already broken ground on the new Scott Institute for Energy Innovation—a campus-wide initiative looking into future energy sources, uses and innovation.

In early October, we celebrated Cèilidh, a combination of homecoming and family weekend. For SCS, this year's Cèilidh was highlighted by the debut of Polaris, the prototype for a new solar-powered lunar rover designed to search for ice at the moon's poles. Developed by CMU spinoff Astrobotic Technology, Polaris was designed under the guidance of Red Whittaker (E'75, '79), the company's CEO, CMU’s Fredkin Professor of Robotics and director and founder of the Field Robotics Center at our Robotics Institute. Astrobotic, in partnership with the university, is trying to win the $20 million Google Lunar X Prize.

Alumni, parents and students who participated in Cèilidh got to meet Red and see Polaris up close on Oct. 6 in the highbay of the Planetary Robotics Center, several days before the rover prototype was revealed to the rest of the world.

If you missed Cèilidh this year, it’s not your only chance to visit us on campus this fall and winter. There are always a variety of events on campus, including very interesting speakers and activities, which are open to alumni and other visitors. For the latest news, check out the SCS calendar at www.cs.cmu.edu, “like” us on Facebook and follow us on Twitter @SCSatCMU. We’ll also be looking for you at Spring Carnival, April 18–20, 2013. (We are also planning a new-look SCS alumni page soon—watch this space!)

We look forward to seeing you here and “on the road” when we visit the worldwide Carnegie Mellon community!
Some snapshots from our July 14 combined SCS/ECE event for Bay Area alumni at the San Francisco Museum of Modern Art

First row left, Dana Sofman, Boris Sofman (E’05, CS’05,’07,’10), Alex Gutierrez (E’03, CS’05) and Michelle Kam. First row right, SCS Dean Randy Bryant, Eric Daimler (DC’94,CS’10), Alex Gutierrez (E’03, CS’05)

Third row, unidentified guest, Michael Coblenz (S’05, CS’05,’06), guest, Mel Ludowise (CS’06)

Fourth row left, Sharon Wong (CS’09) and Steven Hillenius (CS’09, DC’09). Fourth row right, “future SCS alumni” Natalie Hildebrandt (CS’13) and Cory Mead (CS’14)
Several hundred alumni, family and friends enjoyed the annual summer gatherings held on land and sea in Boston, San Diego and Seattle. First row left, Mark Stehlik poses with alumni in Boston on June 23 just before leaving for his new position at CMU Qatar. Front: Robert Holcomb (CS’06), Harriet Holcomb (CS’06), Anita Taylor (CS’07), Krishan Taylor (CS’10), Stehlik, Yuxiang Liu (CS’06), Robert Timmerman (E’10), Laurie Damianos (S’85, CS’94). Back: Fritz Knabe (CS’91, ’95), David Black (CS’88, ’90), Dean Rubine (CS’91), Kwasi Mensah (CS’08), Ryan Caloras (CS’10), Thomas Tuttle (CS’11). First row right, Anita Taylor (CS’07) and Dean Rubine (CS’91) in Boston.

Second row left, SCS Dean Randy Bryant shares the latest campus highlights with an attentive audience in Boston. Second row right, guests Susan Lee and Angela Ting enjoying the picture perfect weather during the Seattle alumni dinner cruise on July 8.

Third row left, Jack F. Chen (CS’11) and guest in Seattle. Third row right, Harry Shum (CS’96), former Computer Science Department head Peter Lee and Desney Tan (CS’04).

Fourth row left, David Cummings (CS’14), Ranika Kejriwal (E’13) with guests Najla Elmachtoub and Vidhita Agarwal. Fourth row right, Stefanie Tomko (CS’01, ’07) and Daniel Gaugel (E’01).
We’re in the final months of the university’s “Inspire Innovation” campaign, which concludes June 30, 2013. And while we’ve achieved a lot, we’re striving to reach as far as we can over $1 billion. (As of July 31, the campaign stood at $1.07 billion.)

What’s been achieved? Well, we started the campaign with three principal goals—raising money for the university’s endowment, raising brand awareness of Carnegie Mellon University and building community by increasing alumni engagement. We’ve been successful on all of those fronts.

In addition to those goals, the Inspire Innovation campaign was designed to help us build the advancement infrastructure and alumni engagement that will allow CMU to continue growing well into the future. We’ve made some great leaps forward, but there’s a lot of work left to do. It’s no great secret that Carnegie Mellon lags its peer institutions in the size of our endowment per student. That has a direct impact on the cost of a CMU education. For the university to continue to support the bright and creative students that it’s attracted for the past 100 years, it simply must continue to add to that endowment.

That’s an important reminder that money we raise is more than just an abstract number. It translates directly into helping people at Carnegie Mellon—through scholarships, fellowships for graduate students and endowed faculty chairs.

Increasing philanthropic support is a challenge for any non-profit, given the growing number of non-profit organizations seeking contributions these days. CMU is fortunate to have a loyal and committed base of alumni and friends who recognize the importance of supporting the great students, faculty and research that takes place here.

Part of the “Inspire Innovation” campaign took place during the economic crisis and downturn. Believe me, we had some concerns about hitting our targets. But many, many, many friends, alumni and others who believe in the work that CMU does wanted to help us achieve our goals and continue our mission—and the proof is in the resulting success of the fundraising campaign. The chair of the Inspire Innovation campaign is Ed Frank (CS’85), a member of CMU’s board of trustees. Ed is fond of saying, “If you want to change the world, give to a university.” Alumni, friends and parents have demonstrated this through their support of CMU.

The School of Computer Science has been the recipient of some extraordinary gifts from our friends, including the $20 million from the Bill & Melinda Gates Foundation and the $10 million from the Henry L. Hillman Foundation that made the Gates and Hillman Centers possible. Our largest alumni donation to date is from Chuck Geschke (CS’73), former president and chairman of the board of Adobe Systems, whose gift created an endowed directorship of the Human-Computer Interaction Institute. (See page 39.)

And although large gifts justifiably get headlines, one of the reasons that SCS has made such progress over the course of the campaign has been through increasing our alumni engagement at every level. All gifts—whether they’re of $5, $25 or $50—help us demonstrate to large institutional donors that our alumni are committed, involved and believe in the education they received at Carnegie Mellon University. [→]

By Mark Dorgan
Increasing philanthropic support is a challenge for any non-profit, given the growing number of non-profit organizations seeking contributions these days. CMU is fortunate to have a loyal and committed base of alumni and friends who recognize the importance of supporting the great students, faculty and research that takes place here.

Gifts in any range can make a difference, whether it comes to funding research or attracting the right grad students. All donors have the ability to target specific programs at CMU such as TechBridgeWorld or the University Libraries. There are funds within SCS as well that can be targeted, such as the Dean’s Innovation Fund, which allows the dean’s office to move swiftly to support emerging research opportunities at all levels—faculty, undergraduate and graduate. In some cases, affinity groups have worked together to raise money for special projects. In SCS, the Alumni Advisory Board led the way, bundling their individual gifts together to fund a suite of offices in the Gates Center, in addition to making individual gifts. We’re also grateful to the many faculty and staff who have given to the university, sometimes through payroll deductions. Demonstrating that our faculty and staff are committed to the university’s future has helped us make our case to institutional donors. We have numerous examples of faculty and staff who have endowed scholarships or named rooms or other facilities, including the chairs in the Rashid Auditorium. (One thing that has helped our fundraising efforts has been that so many of our faculty and staff are willing to say to our successful students, “I give—you should consider giving, too!”) Finally, one intangible benefit of topping the $1 billion mark has been the growing perception regionally, nationally and internationally that Carnegie Mellon has built up momentum that will help us continue to expand our reach well into the future. Having that momentum helps demonstrate to the world that Carnegie Mellon is a special and unique place that really holds meaning for the people whose lives it has touched. To find out how you can help the School of Computer Science through scholarships, fellowships, faculty support or other gifts, please contact me at mdorgan@cmu.edu, or call me at 412-268-8576. You can also learn more about the Inspire Innovation campaign by visiting www.cmu.edu/campaign.

Mark Dorgan is executive director of major gifts and development liaison for the School of Computer Science.
Many great ideas to improve existing services have gone by the wayside because users decided the intangible costs of switching weren’t worth the effort, says Andrew Cove (CS’05, ’06). “If you need a certain app to do something, that’s a hurdle, and it makes switching a very unappealing thing,” he says.

Some of those ideas don’t make sense at a small scale. They’d work well if they achieved a certain market penetration, but they never reach that level because potential customers can’t get past the “friction” of switching from an entrenched technology to a new, untried model, Cove says. Success or failure in those cases depends on a startup’s plan to get over that initial batch of friction.

Cove is hoping the new idea that he’s developing with fellow CMU alum Mark Egerman (CS’04) has cracked that problem. They’re entering the crowded field of mobile payments—dominated by established players such as Visa and MasterCard—by targeting restaurants. While the details of their plan are still being kept quiet, Cove will say the adoption cost of their idea is low, it requires no special hardware and using it will be nearly effortless for both consumers and restaurant owners. They’re already testing it in a handful of New York City restaurants.

Mobile payments are a new area for Cove, who has made several stops since graduation, including at computer game developers Naughty Dog and Sanzaru. Working for gaming companies gave Cove an appreciation for seamless and enjoyable user experiences. He later worked for IA Ventures and with AngelList—an online network that matches investors with entrepreneurs—and says those “extremely complementary” experiences instilled the “very strong urge” to start his own business. “AngelList showed me the market and built up my intuition, but IA is where I learned the fundamentals,” he says. “In some ways, it was a crash-course MBA. It gave me the opportunity to explore a lot of problems that startups have.”

His understanding of user interfaces and entrepreneurship should prove to be valuable as Cove and Egerman test their project and get ready for a formal launch.

While at CMU, Cove spent a lot of his free time exploring his interest in music, both as a performer in a garage band called “Eye on the Wall” and as a technician, crafting mixes at the recording console until the wee hours of the night. Although Cove still enjoys music, he has a new hobby—exploring his new home of New York City. “I’ve lived in suburban south Florida, Pittsburgh, Santa Monica and Los Angeles, and then San Francisco, and New York is so dramatically different from all of those that it’s like a cultural playground,” he says. “There are so many different parts of the city to explore, so much cultural activity and so much diversity, that when I have nothing to do, I go out and explore the city.”

New York’s many restaurants are one of the city’s attractions. They also provide a research bed for mobile payment ideas. “One of the benefits of working in the ‘dining’ space is that we have excuses to go out to eat a lot,” Cove says, laughing.

—Jason Togyer (DC’96)
Targeting advertising toward specific users isn't new, says Emile Litvak (CS’96, ’97). As far back as the 1970s, marketers were using direct mail to target their pitches to people based on their catalog purchases and magazine subscriptions.

But unlike direct mail, online advertisers can’t work with windows measured in months or weeks. Their decisions must be made in milliseconds.

In many online advertising models, advertisers pay for placements by bidding on the best available spots. Websites allocate ad space based on auctions that must be completed, for all intents and purposes, instantly.

“Some of the companies we know and love, such as Facebook, depend solely on advertising revenue to provide the free services we use,” Litvak says. “The more money they generate from advertising, the more services they can provide.”

Whether they’re targeting viewers based on their social media preferences or their queries on search engines, advertisers need reliable data to decide what ads to serve and how much to charge the advertisers, and they need it with the lowest latency possible. The algorithms are “computationally intense,” Litvak says.

Litvak is chief architect at Redwood City, Calif.-based Turn, which harnesses the power of distributed, parallel computing—the “cloud”—to make those decisions. The company’s software is currently being used by 75 of the top 100 U.S. advertisers and works on Web, mobile and video platforms.

In the 1800s, department store pioneer John Wanamaker famously quipped that 50 percent of his advertising was wasted, but he didn’t know which 50 percent. Things are improving somewhat, Litvak says. “Data-driven advertising is rapidly gaining traction because of its impressive return on investment,” he says. Online advertising is providing solid measurements of demographics and response rates that were hard to determine for traditional forms of advertising such as print ads and billboards, Litvak says. “It’s still something of an art as much as it is a science,” he says. “We’re still in the early days of making advertising relevant and efficient. I think we’ve just scratched the surface. One of the things I like about the advertising market is that it never gets boring. The technology moves really fast.”

Carnegie Mellon continues to play an important role in Litvak’s life. A good number of Turn’s 100 or so engineers are CMU graduates, and he’s had three interns from SCS. Litvak also stays in touch with alumni such as technology “angel investor” Manu Kumar (E’95, CS’97, TPR’99) and Jonathan Betz (CS’99).

But playing an even more important role these days are Litvak’s wife, Karly, and their children, Elijah and Isabella. “I’m more aware now than I used to be that it’s important to have a work-life balance,” Litvak says. “It’s considerably more difficult to be a great parent than to be a great software architect. It’s a great equalizer, and no amount of great education will prepare you for it.”

—Jason Togyer (DC’96)
Yuan Zhou, a doctoral student in the Computer Science Department, has been awarded a Simons Graduate Fellowship in Theoretical Computer Science for his research into approximation algorithms and optimization problems.

Awarded by the New York City-based Simons Foundation, which supports research into mathematics and basic sciences, the fellowship is designed to identify emerging stars in theoretical computer science. The two-year award covers tuition, fees, travel and other expenses.

A 2009 graduate of Tsinghua University, Zhou is co-advised by Venkat Guruswami and Ryan O’Donnell, both associate professors of computer science at CMU.

He also publishes work on other topics of theoretical computer science, including analysis of Boolean functions, algebraic dichotomy theory, algorithmic game theory and quantum information theory. [link]

SCOTT INSTITUTE PROVIDES HOME FOR CAMPUS-WIDE ENERGY INNOVATION

A new building will change the face of CMU’s Pittsburgh campus. But the research that will be done inside that building might change the world’s energy choices in years to come.

Sherman Scott (E’66) and his wife, Joyce Bowie Scott (A’65), a CMU trustee, joined university President Jared Cohon, CMU Board of Trustees Chair Ray Lane, Pittsburgh Mayor Luke Ravenstahl and other dignitaries on Sept. 22 to break ground for Scott Hall.

The new building, being constructed above Roberts Drive near Wean and Hamerschlag halls, will house the Wilton E. Scott Institute for Energy Innovation. Mark Kamlet, the university’s provost and executive vice president, and Charles McConnell, assistant secretary of the U.S. Department of Energy, also participated in the celebration.

Named for Sherman Scott’s father, the newly created institute is described as a “major research and education initiative” focused on developing new, clean, affordable and sustainable energy sources. Several SCS faculty are expected to play key roles in research at the Scott Institute, a university-wide effort which will pull together work being done across all of CMU’s schools and colleges.

“In energy, Carnegie Mellon is one of the world’s leaders in smoothly combining technology and policy-focused research,” says M. Granger Morgan, the university’s Thomas Lord Professor of Engineering and head of the Department of Engineering and Public Policy. “This allows us to avoid abstract policy discussions and focus on creating strategies that give the private energy sector the right incentives to advance secure, reliable and low-environmental impact energy sources,” says Morgan, who will serve as director of the Scott Institute.

Sherman Scott is president and founder of Delmar Systems, which provides engineering and anchoring services for offshore oil and gas drilling platforms. “Energy is a precious resource, and Carnegie Mellon’s systems approach can create solutions that ensure we produce and use energy more efficiently,” he says. “By bringing together experts from a range of disciplines, Carnegie Mellon is the perfect place to help meet the energy challenges of the future.”

Support for Scott Hall has also come from John Bertucci (E’63, TPR’65) and his wife, Claire Ruge Bertucci (MM’65); CMU alumnus Jonathan Rothberg (E’85) and his wife, Bonnie Gould Rothberg; and the Eden Hall Foundation.

CS DOCTORAL STUDENT ZOU AWARDED SIMONS FELLOWSHIP

Artist’s rendering of the new Scott Hall

Sept. 22 groundbreaking
Five graduate students at SCS have been named to the 2013 class of Siebel Scholars by the Siebel Scholars Foundation.

The program recognizes talented students at the world’s leading graduate schools of business, bioengineering and computer science who are chosen on the basis of outstanding academic achievement and demonstrated leadership. Each receives a $35,000 award for their final year of study.

Sanjiban Choudhury is a master’s student in robotics, with plans to pursue a Ph.D. in robotics. A graduate of the Indian Institute of Technology at Kharagpur, Choudhury is working on the flight and steering mechanisms of autonomous helicopters. Choudhury is passionate about developing robotics research in India, organizing and leading workshops at the grassroots level.

Ruta Desai is a master’s student in robotics whose research focuses on legged robotics. She is currently working with Robotics Institute professors Chris Atkeson and Hartmut Geyer on developing controls for automated balance recovery in the presence of large disturbances like trips and pushes. Her research is directed toward better design and control for artificial legs and locomotion in humanoid robots.

Min Kyung Lee is a Ph.D. candidate in the Human-Computer Interaction Institute. Her research focuses on understanding how people make sense of intelligent, personalized systems—including assistive robots, speech based interfaces and “smart homes”—and designing them to improve people’s lives. Her dissertation addresses the question of how users can personalize and control autonomous systems.

Martina Rau is a doctoral student in HCII and an associate in the Program for Interdisciplinary Education Research. She conducts research on Intelligent Tutoring Systems with a focus on cognitive science theory. In 2009, she received the best student paper award at the 14th International Conference on Artificial Intelligence in Education.

Zeyu Zheng is a master’s student in the Language Technologies Institute and is researching the area of domain adaptation. This work builds on successful research he began while doing an internship at Microsoft Research Asia during his undergraduate computer science education at Peking University.

Edmund Clarke and Manuela Veloso, professors of computer science, were among the distinguished scientists invited to give talks at a celebration of the 100th anniversary of the birth of Alan Turing, one of the most influential computer scientists of all time.

The Alan Turing Centenary Conference was held June 22 to 24 at the University of Manchester in England.

In 2007, Clarke was a recipient of a Turing Award, the highest honor in computer science. He was one of nine Turing laureates who were invited to speak at the conference and is one of four Turing laureates who are current or emeritus faculty at Carnegie Mellon. Clarke’s lecture was entitled, “Model Checking and the Curse of Dimensionality.”

Veloso recently became president of the Association for the Advancement of Artificial Intelligence. At the Manchester conference, she discussed the development of CoBots—the robots that were recently deployed in CMU’s Gates and Hillman Centers to guide visitors and deliver packages. Her lecture was entitled “Symbiotic Autonomy: Robots, Humans, and the Web.”

Other invited speakers included Vint Cert, Google senior vice president and Turing laureate; David Ferrucci, who led development of IBM’s Watson question-answering system; and chess grandmaster Garry Kasparov.
LTI-SPINOFF SAFABA OFFERS CUSTOMIZED TRANSLATIONS FOR SPECIALIZED USERS

A customized language translation system developed by a CMU spinoff provides quicker, better translations that incorporate language or phrases unique to a specific business or field.

The new service from Safaba Translation Solutions LLC allows users to generate automatically translated tests that conform to a client’s specialized vocabulary, Alon Lavie, a research professor in CMU’s Language Technologies Institute and the president and CEO of Safaba, says the software has built-in appeal for companies that market products in many different international markets.

Commercial machine translation programs can garble slogans, idioms and proprietary information. The Safaba service is tweaked to make sure that special messages aren’t, quite literally, lost in the translation.

In addition, because the service is optimized for specific clients and domains, it can provide translations twice as fast as conventional methods, says Lavie (CS ’93, ’96). “Human translators typically produce about 2,500 words per day. With Safaba’s machine trans-...
CMU LAUNCHES UNDERGRADUATE ROBOTICS MAJOR

Students pursuing computer science, engineering or other undergraduate degrees at Carnegie Mellon University now have the option to include an additional major in robotics.

The Robotics Institute, which created the first Ph.D. and master’s degree programs in robotics, already offers more undergraduate robotics courses than any other university in the world and for the past 12 years has offered an undergraduate minor in robotics. The additional major responds to the growing interest of students in robotics careers, and to demands by employers for more graduates with a deeper understanding of the field.

"Undergraduates already are an important part of the institute, working side by side with our researchers on some of our most exciting projects," says Matt Mason, director of the Robotics Institute. "Providing the option of robotics as an additional major just seems like the natural next step."

Robotics draws heavily from mechanical engineering, computer science and electrical engineering, among other disciplines. Many of the students interested in the additional robotics major will be pursuing conventional undergraduate degrees in those subjects, says Howie Choset, professor of robotics and director of the undergraduate major. But the program is open to students from any department on campus, he says.

"Robotics is inherently multidisciplinary and interdisciplinary," says Choset, who has also overseen the undergraduate minor. "As robotic technology finds applications in areas ranging from the arts to archeology, we anticipate that students from many disciplines will seek to study robotics and ultimately make contributions to robotics."

The curriculum includes instruction on control systems, movement, machine perception, systems engineering and cognition and reasoning. Hands-on courses focus on designing, building and programming robots.

Students interested in the additional major should plan to apply for the program during the fall semester of their freshman year, though sophomores also are welcome to apply.

HCII’S HARRISON NAMED TO TECHNOLOGY REVIEW 35

A Ph.D. student in the Human-Computer Interaction Institute has been named to Technology Review’s list of the top 35 innovators under the age of 35.

Chris Harrison’s research focuses on finding alternatives to the keyboard-and-mouse technologies people typically use to control computers. Using combinations of sound and vision sensors, Harrison has devised techniques for people to control electronic devices by tapping on tables, walls or even their own skin.

A native of England who grew up in New York City, Harrison has already developed or helped to develop several products that have been commercialized, or which are in the process of coming to market. Those include Lean and Zoom, which adjusts the magnification of a computer monitor based on a person’s distance from the screen; Skinput, a method for controlling devices by tapping buttons projected onto a person’s own skin; OmniTouch, a Kinect-based system that turns almost any surface into a touchscreen; and Touché, a new sensing technique that Harrison worked on as part of a team at Disney Research, Pittsburgh.

Harrison came to HCII in 2007 after completing his undergraduate and master’s degrees at New York University. “My training and my inspiration come from the people who I work with,” he says. “The graduate students in our HCII Ph.D. program are the smartest bunch of students in the world. They inspire me every day, and my adviser, Scott Hudson, does the same. It’s not an accident that I’m able to create these new technologies. It’s the environment that I’m in.”

A panel of expert judges selected the TR35 winners from more than 250 nominations. All 35 winners were featured in Technology Review’s September-October issue.

“I can’t think of a better addition to the TR35 pantheon,” says Justine Cassell, director of HCII. She says that Harrison has a “vision” of how interfaces need to change as our computer environment changes, as well as the technical skill to make his ideas work. “Computing is everywhere these days, but we often find ourselves using new devices the same way we use our old computer,” she says.

Harrison joined other TR35 honorees in discussing their achievements during the EmTech MIT 2012 conference at the MIT Media Lab in Cambridge Oct. 24-26. 

Chris Harrison

Chris Harrison

Students pursuing computer science, engineering or other undergraduate degrees at Carnegie Mellon University now have the option to include an additional major in robotics.

The Robotics Institute, which created the first Ph.D. and master’s degree programs in robotics, already offers more undergraduate robotics courses than any other university in the world and for the past 12 years has offered an undergraduate minor in robotics. The additional major responds to the growing interest of students in robotics careers, and to demands by employers for more graduates with a deeper understanding of the field.

"Undergraduates already are an important part of the institute, working side by side with our researchers on some of our most exciting projects," says Matt Mason, director of the Robotics Institute. "Providing the option of robotics as an additional major just seems like the natural next step."

Robotics draws heavily from mechanical engineering, computer science and electrical engineering, among other disciplines. Many of the students interested in the additional robotics major will be pursuing conventional undergraduate degrees in those subjects, says Howie Choset, professor of robotics and director of the undergraduate major. But the program is open to students from any department on campus, he says.

"Robotics is inherently multidisciplinary and interdisciplinary," says Choset, who has also overseen the undergraduate minor. "As robotic technology finds applications in areas ranging from the arts to archeology, we anticipate that students from many disciplines will seek to study robotics and ultimately make contributions to robotics."

The curriculum includes instruction on control systems, movement, machine perception, systems engineering and cognition and reasoning. Hands-on courses focus on designing, building and programming robots.

Students interested in the additional major should plan to apply for the program during the fall semester of their freshman year, though sophomores also are welcome to apply.

HCII’S HARRISON NAMED TO TECHNOLOGY REVIEW 35

A Ph.D. student in the Human-Computer Interaction Institute has been named to Technology Review’s list of the top 35 innovators under the age of 35.

Chris Harrison’s research focuses on finding alternatives to the keyboard-and-mouse technologies people typically use to control computers. Using combinations of sound and vision sensors, Harrison has devised techniques for people to control electronic devices by tapping on tables, walls or even their own skin.

A native of England who grew up in New York City, Harrison has already developed or helped to develop several products that have been commercialized, or which are in the process of coming to market. Those include Lean and Zoom, which adjusts the magnification of a computer monitor based on a person’s distance from the screen; Skinput, a method for controlling devices by tapping buttons projected onto a person’s own skin; OmniTouch, a Kinect-based system that turns almost any surface into a touchscreen; and Touché, a new sensing technique that Harrison worked on as part of a team at Disney Research, Pittsburgh.

Harrison came to HCII in 2007 after completing his undergraduate and master’s degrees at New York University. “My training and my inspiration come from the people who I work with,” he says. “The graduate students in our HCII Ph.D. program are the smartest bunch of students in the world. They inspire me every day, and my adviser, Scott Hudson, does the same. It’s not an accident that I’m able to create these new technologies. It’s the environment that I’m in.”

A panel of expert judges selected the TR35 winners from more than 250 nominations. All 35 winners were featured in Technology Review’s September-October issue.

“I can’t think of a better addition to the TR35 pantheon,” says Justine Cassell, director of HCII. She says that Harrison has a “vision” of how interfaces need to change as our computer environment changes, as well as the technical skill to make his ideas work. “Computing is everywhere these days, but we often find ourselves using new devices the same way we use our old computer,” she says.

Harrison joined other TR35 honorees in discussing their achievements during the EmTech MIT 2012 conference at the MIT Media Lab in Cambridge Oct. 24-26. 

Chris Harrison

Chris Harrison
Human-Computer Interaction Institute Director Justine Cassell talks to Chuck Geschke (CS’73) during the demonstration of a Virtual Peer named Alex. Alex is designed to help children acquire science literacy and the ability to maintain their “home” dialect while also learning how to speak in a classroom or mainstream dialect. Also shown are grad student Samantha Finkelstein, post-doctoral researcher Amy Ogan and ArticuLab manager Evelyn Yarzebinski.

Geschke and his wife, Nancy, toured HCII on Sept. 10 during a celebration to mark the official installation of Cassell as the first Charles M. Geschke Director of the Human-Computer Interaction Institute.

The director’s post has been newly endowed thanks to a gift from the Geschkes. The amount of the donation has not been disclosed. Cassell became director of the HCII in 2010. Under terms of the gift, she and each succeeding HCII head automatically receive an appointment as the Geschke Director.

Along with John Warnock, Geschke in 1982 founded Adobe Systems, and the men remain co-chairs of the company’s board of directors. Adobe helped launch the desktop publishing revolution and several of its products, including Acrobat and Photoshop, are de facto industry standards for graphics, publishing and printing. In 2005, Adobe expanded further into online publishing with its acquisition of Macromedia, developer of the Flash interactive graphics technology and the Dreamweaver web software suite.

In 2009, Geschke received the National Medal of Technology and Innovation, and in 2010 he was awarded the Marconi Prize for achievements in information technology.

Cassell’s research focuses on computational systems that use conversation and storytelling to enhance learning and communicative skills in humans. Last January, Cassell spoke about her research at the World Economic Forum in Davos, and she is currently the chair of one of its Global Agenda Councils.
then and now:

Ivan Sutherland

That’s Ivan Sutherland with the great-granddaddy of today’s Mobots. Long before his pioneering work in computer graphics, Sutherland (E’59, H’03) was interested in robots that could navigate mazes and react to stimuli much as an animal would.

Recipient of the A.M. Turing Award in 1988 and many other professional honors, Sutherland is currently a visiting scientist at Portland State University. In June, he received the Inamori Foundation’s 2012 Kyoto Prize in Advanced Technology for his achievements in computer graphics and interface design.

As students in the New York City suburbs, Sutherland and his older brother, Bert, got jobs working for ACM co-founder Edmund Berkeley. Impressed by their enthusiasm and intelligence, Berkeley provided both funding and guidance for their experiments. After Berkeley built a robot called “Squee” that could chase and retrieve tennis balls, the Sutherlands designed two of their own “mechanical animals.”

Ivan Sutherland’s third such robot, completed during his senior year at Carnegie Tech, was Machina versatilis, shown here with its inventor. With sensors and guidance mechanisms powered by 36 transistors using 10 flashlight batteries, M. versatilis was able to “chase lights, squeal appealingly when it bumps something and attempt to avoid the obstacle.”

Sutherland went onto develop Sketchpad, the world’s first computer drawing program, as well as early virtual-reality displays and 2D and 3D imaging techniques. But he returned to studying “mechanical animals” at CMU in the early 1980s, when he designed and built a six-legged, hydraulically powered walker large enough to carry a passenger.

—Jason Togyer (DC’96)
All events to be held on the Carnegie Mellon University campus in Pittsburgh, unless otherwise noted. Dates and locations subject to change without notice. Visit calendar.cs.cmu.edu for a complete and current listing of events.

Oct. 28–29
SCS Sleeping Bag Weekend

Oct. 31
Computer Science Department Distinguished Lecture
Kurt Melhorn, director, Max Planck Institut fur Informatik, Saarbrücken, and professor of computer science, Saarland University
“Certifying Computations Towards a Dependable Algorithmic Substrate”
Noon, Gates and Hillman Centers 6115

Nov. 6
Intelligence Seminar: Milind Tambe, University of Southern California
“Security and Game Theory: Key Algorithmic Principles, Deployed Applications, Lessons Learned”
Noon, Gates and Hillman Centers 6115

Nov. 7
HCII Z-Axis Seminar: Danah Boyd, senior researcher, Microsoft, and research assistant professor in media, culture and communication, New York University
“Visibility: The Challenges of Seeing and Being Seen in a Networked Age”
4:30 p.m., Rashid Auditorium, Gates and Hillman Centers

Nov. 12
Tartan Carnival, Qatar Campus
5–9 p.m.

Nov. 12–16
Spring 2013 registration week

Nov. 21–23
Thanksgiving holiday; no classes

Nov. 25
Andrew Carnegie born, Dunfermline, Scotland, 1835

Nov. 27
INET Qatar: The Rise of the Arab Information Society
8 a.m.–5:30 p.m.
Assembly Area, East Walkway, West Walkway, Conference Room 1181, Moot Boardroom 1131, Qatar Campus

Dec. 7
Last day of classes

Dec. 8
CS4Qatar for Women
8 a.m.–5:30 p.m.
Assembly Area, Food Court, Lecture Hall 1202 and Computer Classroom 1185, Qatar Campus

Dec. 10–18
Final exams

Dec. 12
HCII Ph.D. Evaluation Meeting

Dec. 13–14
CSD Black Friday
Gates and Hillman Centers 6115

Dec. 17
Robotics Black Friday
9:30 a.m., Newell-Simon Hall 3305

Dec. 20
Final grades due, 4 p.m.

January 5, 2013
India alumni panel and reception, Mumbai

January
Network Night, Silicon Valley (date and location TBA)

Jan. 8
Mid-semester break, no classes

Jan. 11–15
Spring break, no classes

April 15
Summer 2013 registration begins

April 18–20
Spring Carnival and Reunion Weekend, no classes

April 22–26
Fall 2013 registration week

May 4–14
Final exams

May 16
Final grades due for graduating seniors

May 18–19
Commencement Weekend

May 20
Summer classes begin

May 21
Final grades due for non-graduating students

May 27
Memorial Day, no classes
Step up to the challenge.

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Show Your Pride

Our thanks to thousands of alumni and students who support CMU in multiple ways each year!