

THE LINK

Carnegie Mellon

News from the School of Computer Science

Issue 4.2 / Winter 2009



We're In!

GETTING TO KNOW THE GATES AND HILLMAN CENTERS—THE GLASS, THE GRASS AND THE 'SQUIGGLY THING' IN THE MIDDLE

Also Inside:

20 YEARS OF CHANGE: MSE MARKS A MILESTONE
HUMAN FACTORS IN COMPUTER SECURITY
GORILLAS, WIKIPEDIANS AND TRANSLATORS

News from the School of Computer Science

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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CALENDAR OF EVENTS

All events to be held at the Carnegie Mellon University campus in Pittsburgh, unless otherwise noted.

January 5

Seattle Alumni Network Night
Sponsored by Microsoft

January 6

Silicon Valley Alumni Network Night
Sponsored by Oracle

January 7

Los Angeles Alumni Network Night
Hosted by NBC Universal

January 11

Spring semester begins

January 18

Martin Luther King Jr. celebration
Programming begins at noon

January 21

Katayanagi Prizes Award Ceremony and Lecture
Jon Kleinberg, Department of Computer Science, Cornell University
"Meme-Tracking, Scheduling, and the Flow of On-Line Information"
*Rashid Auditorium, 4401 Hillman Center
4 p.m.*

February 11

Washington, D.C., Alumni Network Night

February 26

Pittsburgh Alumni Network Night

March 9

Boston Alumni Network Night
Sponsored by Vistaprint

March 12-13

Master of Software Engineering:
20th Anniversary Celebration

March 14

Pi Day (*celebrate by acting irrationally*)

April 15-17

Spring Carnival and Reunion Weekend

April 30

Last day of spring term classes

May 3-11

Final exams

May 16

Commencement

F E E D B A C K L O O P

We know there are a lot of Steelers fans in "SCS Nation." Well, we have something for you.

Dan Hart, the Pittsburgh-based illustrator who did the portrait of Rick Rashid for our Summer 2009 issue, has created a great poster—suitable for framing—to celebrate the Steelers' victory in Super Bowl XLIII.

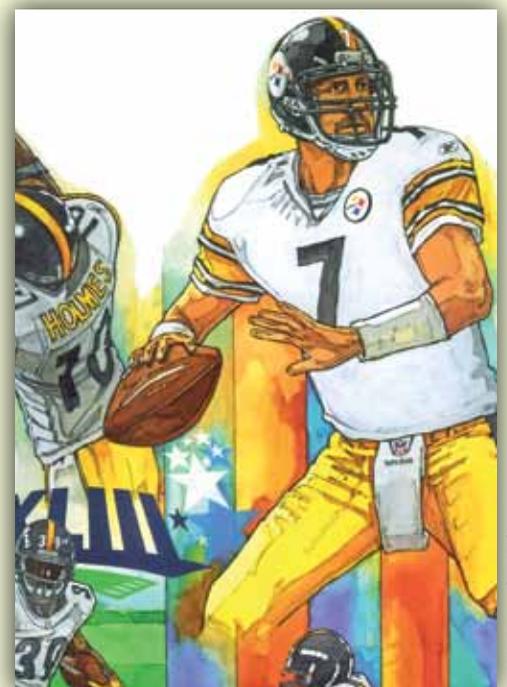
You can win one by sending a letter to the editor before our next issue goes to press in April. Three winners will be selected at random.

To enter, email your comments, questions or suggestions about the magazine or any of our articles to TheLink@cs.cmu.edu, or write to The Link Magazine, Office of the Dean, School of Computer Science, 5000 Forbes Ave., Pittsburgh, PA 15213.

Just don't wait until Super Bowl 101100!

P.S.: You can also leave comments at our Web site, link.cs.cmu.edu, or find our Facebook page (it's open to everyone) at <http://tinyurl.com/linkscs>.

Jason Togyer (HS'96), managing editor



DAN HART ILLUSTRATION

C O N T E N T S



8 / We're In!

Bill Gates calls it that “big squiggle” in the middle of the Gates Center for Computer Science. We call it the Helix. It turns out that we all have a lot to learn about the Gates Center and the new Hillman Center for Future-Generation Technologies, and it's been fun so far.

By Jason Togyer



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The master of software engineering program started out as a relatively small effort. It's since become a benchmark for similar academic programs around the world. The MSE program celebrates its 20th anniversary in March, and it's not content to rest on its past successes.

By Jennifer Bails

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Bossa Nova Robotics isn't monkeying around with its first commercial products, while the Lane Center for Computational Biology has moved up to department status. Bob Kraut and Niki Kittur are watching you Wikipedians work, and Alex Waibel and the International Center for Advanced Communication Technologies are making it easier for us to understand one another.

13 / In the Loop

Sara Kiesler, CMU's Hillman Professor of Computer Science and Human-Computer Interaction, says you shouldn't jump to conclusions when you talk to your dog—or your robot.

17 / Research Notebook

Computer security professionals have learned that it's often better to keep humans “out of the loop” when it comes to protecting systems and software from malicious code. But there are times when it's better to ask users to make critical security decisions. Lorrie Faith Cranor, director of the CyLab Usable Privacy and Security Laboratory, explains.

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On the Cover:

You may not know David Coulson's name, but you've probably seen his work, especially if you have small children. The Pittsburgh-based artist, who lives an eraser's throw from the Carnegie Mellon campus, creates fun and colorful birds' eye illustrations for Highlights for Children, a staple of pediatricians' offices around the world.

Since a photo doesn't do justice to the new Gates and Hillman centers, we asked David to capture the spirit of the buildings and the people who work inside them.

He's taken a few artistic liberties—one wiseacre pointed out that the Hillman Center's roof isn't really planted, but we're pretty sure we don't have a giant dragon roasting weenies, either.

Besides the dragon and the Scottie dog, how many familiar faces from Carnegie Mellon's past and present can you spot?

Email TheLink@cs.cmu.edu



Randy Bryant, dean of the School of Computer Science, mediates a question-and-answer session between Carnegie Mellon students and Bill Gates, Microsoft Corp. chairman and co-founder and co-chair of the Bill and Melinda Gates Foundation, during Sept. 22 dedication ceremonies for the Gates and Hillman centers on the Pittsburgh campus.

An Exciting Few Months

After more than five years of planning, design and construction, many faculty and staff of the School of Computer Science moved into their new offices in the Gates Center for Computer Science and the Hillman Center for Future-Generation Technologies, just before the fall semester began.

The new occupants are almost uniformly excited by the views, the natural light and the many possibilities for interaction that these buildings provide. With the paint still drying and the outside being transformed via an intense landscaping effort, we held a successful building dedication on Sept. 22, complete with many of our benefactors.

Around one month later, we were able to dedicate the Randy Pausch Memorial Bridge, linking the Gates Center and the Purnell Center for the Arts, thus providing a convenient connection between SCS and the rest of campus.

One of the main features of the new buildings is that our undergraduate students are in our midst for their classes, labs, projects and just hanging out. It's great to have them integrated into our environment, rather than being spread all around campus.

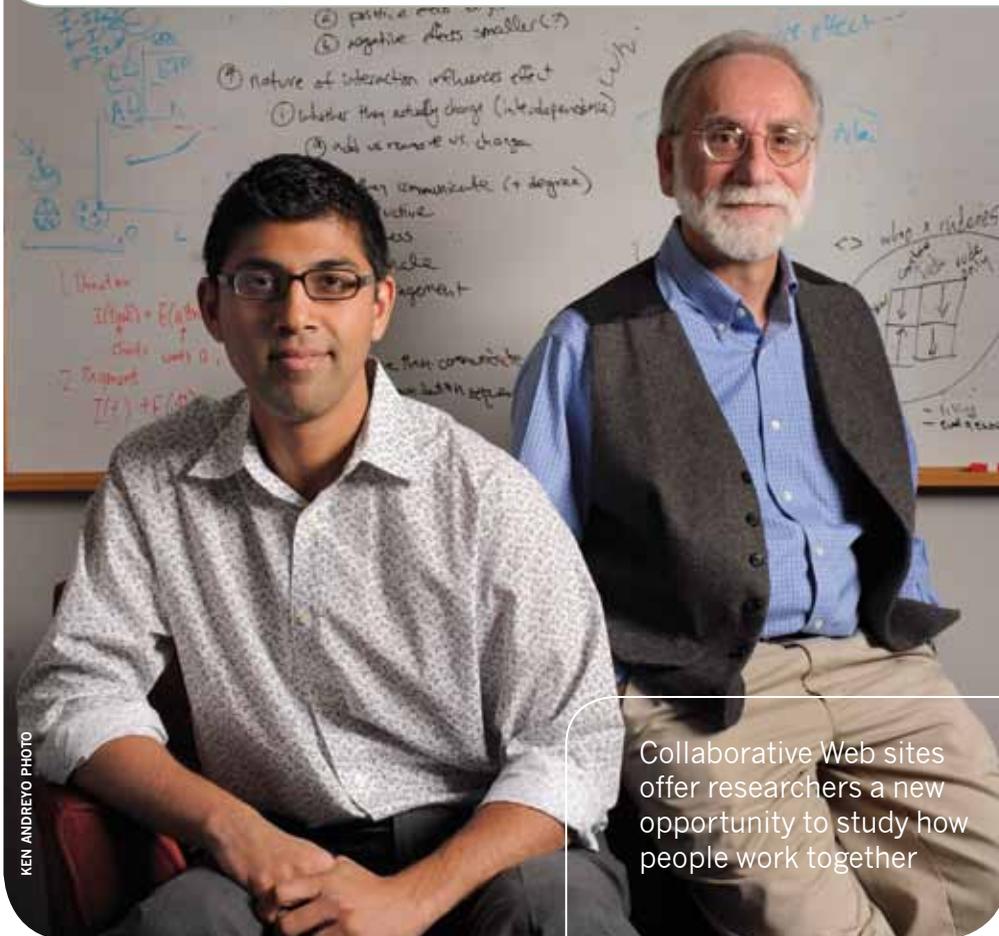
Even though our new two-building complex provides nearly 210,000-square-feet of space, SCS still occupies Newell-Simon Hall (the Robotics Institute and Human-Computer Interaction Institute), Smith Hall (Robotics) and parts of our old, reliable Wean Hall (Institute for Software Research, machine rooms and various labs).

Meanwhile, the real work of the school, with its educational and research mission, continues to proceed at a rapid pace. We have formally given the Lane Center for Computational Biology departmental status, meaning that it can operate with its own faculty and its own graduate programs. This is the next step in the development of computational biology as a major thrust for Carnegie Mellon. Robert Murphy, the Ray and Stephanie Lane Professor of Computational Biology, will continue to direct this effort.

We also held a 25th reunion for participants in the Andrew Project, Carnegie Mellon's groundbreaking initiative to create a wired campus, back when we aspired to provide students access to "3M" machines—having one megabyte of RAM, a one megapixel display and a processor operating at one megahertz. Of course, that was just a black and white display. It's interesting to look back and see how far we've come in the past quarter-century.

All in all, it's been an exciting few months!

Randal E. Bryant
Dean and University Professor
School of Computer Science



KEN ANDREYO PHOTO

Collaborative Web sites offer researchers a new opportunity to study how people work together

in raw kilobytes, articles comprise less than half of the data on Wikipedia, he says, and roughly 40 percent consists of discussions among the participants about dividing up work, debating various changes and making decisions about content. Prior to graduate school, Kittur had been a consultant, so he had personal experience watching diverse groups work together.

“People think of Wikipedia as a technology, but it’s actually a community.”

Niki Kittur

Kraut and Kittur say that quality in Wikipedia doesn’t simply come from the wisdom of the crowd—where averaging the judgments of enough people produces “truth.” In fact, they’re learning that having more contributors doesn’t necessarily make a Wikipedia entry more accurate. Celebrity pages often have hundreds of writers, while pages about mathematical formulas have the fewest number. Yet math pages tend to be the most accurate Wikipedia pages. “A huge number of people working on a page can lead to chaos,” Kraut says. “You get both expertise and energy when you have a large collection of editors working on an article, but you need to coordinate their work to get the benefits.”

Big groups can lead to articles that are disorganized or not coherent, Kittur says, but large groups of contributors also excel at preventing grammatical errors and vandalism—cases where users intentionally write inaccurate information on a page. Kraut says about 35 users working on an article seems to be a “crossover” point—the best balance between accuracy and manageability.

Kraut and Kittur’s studies of Wikipedia are challenging some established rules about how organizations should work. For the past 30 years, Kraut says, organizational psychologists have studied how to train and socialize new employees to ensure that they are hard-working, loyal and happy. Most people in the field believed that what is known as “institutionalized” training works best—for example, training new employees in a group and giving them common experiences before they start the job.

Perhaps this works in the real world, but Kraut and his collaborators—including Bo Choi, a Ph.D. student at CMU’s Tepper School of Business, and John Levine and Kira Alexander of the University of Pittsburgh’s Psychology Department—noticed something different in >>>

Wiki While You Work

> By Meghan Holohan

As a young psychology researcher at Cornell, Robert Kraut visited bowling alleys, attended hockey games and observed pedestrians, watching them, hoping for the glimpse of a smile. After watching scores of people, Kraut and his co-authors concluded that people smile not simply to express joy, but also as a way to smooth their social relationships with others.

Their work was funded in part by a federal grant, and the paper that followed was published in the *Journal of Personality and Social Psychology*. It also earned a Golden Fleece Award in March 1980 from former U.S. Senator William Proxmire, for projects the senator thought were a waste of government money.

But the study had a serious purpose—to understand the evolution of human nonverbal communication. This research has been heavily cited and today, Kraut proudly cites the Golden Fleece Award on his CV, because the paper was a precursor to the then-emerging field of evolutionary psychology, the science of determining why

certain behaviors (like smiling) evolved.

A lot has changed since 1980, but Kraut, now the university’s Herbert A. Simon Professor of Human-Computer Interaction, is still trying to understand how people communicate. Instead of heading to bowling alleys, Kraut is searching Wikipedia edit logs. And while he’s not interested in whether the editors of Wikipedia pages are smiling, he does examine how they work together.

Wikipedia provides the ultimate experiment in Internet democracy. Anyone who wants to contribute to encyclopedic pages on topics ranging from military history to Britney Spears can do so. The volunteers who write these articles aren’t vetted for their expertise or told what to do by a boss, and yet many articles turn out remarkably well. Kraut and Niki Kittur, an assistant professor of human-computer interaction, wondered how the writers organize their work to produce such high quality.

“People think of Wikipedia as a technology, but it’s actually a community,” Kittur says. Measured

Wikipedia. Contributors to Wikipedia projects don't get group training. Instead, they contribute most when they're personally welcomed to the project, offered assistance and given constructive criticism about the work they've done.

Although Wikipedia may just operate differently from conventional off-line groups, the more likely possibility, according to Kraut, is that the earlier researchers got bad data and drew the wrong

conclusions. Because it's almost impossible for organizational psychologists to go into the workplace, those researchers relied on self-reported survey data, which is often fraught with inaccuracies. In contrast, Wikipedia allows the rare opportunity to watch how people work. Since all communication between "Wikipedians" takes place online, and all of their messages and edits are logged, Kraut and Kittur have a complete record of all interactions that took place.

In addition to studying live Wikipedia pages, Kittur and Kraut also have designed controlled studies to see how people work in democratic groups, setting up multiple separate "wikis." Experiment participants who are now being recruited will collaborate on a variety of simple tasks designed by Kraut and Kittur. The investigators hope the carefully measured studies will provide more answers about how people work together online—and perhaps in the real world.

Monkey Business

Pittsburgh's Bossa Nova Robotics takes the fun factor in high technology very seriously

> By Meghan Holohan

"Oh, he's practicing his backstroke," David Palmer says as he watches Prime-8, a robotic toy ape, swim across the office floor into a wall. "He wants to be in the Olympics. He wants to be Michael Phelps."

Palmer sets the squat, yellow-and-black robot upright. But Prime-8 totters over and growls. "I'm sorry," Palmer says. After Prime-8 rights himself, he uses his massive forearms to zip across the floor. The arms work like wheels, giving Prime-8 speed and traction. This robot can run over wood, carpet, tile or grass.

"Normally, (robots) need either big feet or expensive sensor technology to balance," says Sarjoun Skaff (CS'01,'07), one of the founders and chief technology officer of Bossa Nova Robotics, based on South Craig Street near the Carnegie Mellon campus. "We have Prime-8, and he's special because he can balance without any sensors—he balances on his arms."

Skaff and Palmer believe Prime-8—on sale now at Amazon.com and at Bossa Nova's Web site—is the fastest toy robot on the market. And they might be right. Right now, three Prime-8s are dancing in circles before tumbling over, flipping on their backs and then standing on their heads. Their legs kick up and down.

"Mobility is important because you react differently to things that move than to things that are static," Skaff says. "You relate to robots through interaction."

The idea for mass-marketing robots came to Skaff while he was a grad student in robotics at CMU. One day, as he was testing a six-legged robot called RHex on campus, a group of kindergarten students surrounded it. At first, the kids were frightened of the skittering robot. Then, while most of the children shrieked, one boy picked up a stick to prod at the creature. The brave boy inched closer until he finally touched RHex.

Soon the children started playing with RHex as if it were a dog.

"It was a catalyst" for the creation of Bossa Nova, Skaff says. "From the beginning, I wanted to share robots with the public because I think they're very cool," but unfortunately, relatively few robots have been developed for sale to the general public because of the cost of manufacturing them.

To create affordable robots for the mass market, Bossa Nova is using expertise developed at the Robotics Institute to keep manufacturing costs low and make



Bossa Nova Robotics co-founder David Palmer demonstrates Prime-8 with help from intern Roshan Ravindra, a mechanical engineering master's student at Carnegie Mellon.

its robots compelling. While Bossa Nova's first products are for entertainment purposes, Palmer and Skaff hope to some day create personal robots for tasks like education and personal assistance.

"We're demonstrating we know how to design and manufacture products that people want," Skaff says. "We are building on this phase to perhaps offer richer applications targeted to other environments—education, companionship, healthcare."

Most robots advanced enough to be used in education have been unaffordable for average students, Skaff says, so Bossa Nova is looking at inexpensive robots for use in classrooms as a teaching tool. "Hopefully, it would make kids excited about science and technology," he says. "If you write a program for a robot, and you can touch it, see it and share it, the result makes computer programming more interesting. You would see what sensors are used for and likewise, you would learn about robots, how they plan to move, how they recognize spaces and places, and map their environment."

In addition to Prime-8, Bossa Nova has developed a toy for younger children—a pink penguin named Penbo. She waddles like a real penguin, and as Palmer talks to her, Penbo sings "Hello."

"She hears my voice," he says. Palmer rubs Penbo's head and she coos and purrs. She dances and her penguin feet seem to propel her the same way as Prime-8's arms.

As she chatters happily, Palmer touches a heart on her chest, and slowly, a door in her belly opens and an egg emerges. Palmer opens the egg and a fuzzy blue penguin pops out. Immediately, Penbo begins burbling at the baby, and when he moves the little penguin too far away, Penbo searches for her hatchling. Children can play hide and seek with Penbo and her baby.

Penbo is also available from Amazon, and Palmer says Bossa Nova hopes to have the penguin and Prime-8 on sale at major, big-box retailers by next Christmas. And he says both product lines will be expanded, so children can expect more toy robots that will be fun to play with, and which can interact with one another.

Penbo and Prime-8 are more than just toys, Skaff says. They're a way for children to relate to technology. "Children are having fun with it, learning from it, projecting their imagination on it," he says. "And we're giving them an interesting experience that's based on advanced robotics."

Meghan Holohan is a Pittsburgh-based freelance writer who contributes regularly to *The Link*. She also blogs frequently for MentalFloss.com.

A Field—and a Department—Evolve

The Lane Center for Computational Biology becomes SCS's newest academic unit following a summer marked by several research milestones



Ray Lane, chairman of Carnegie Mellon's board of trustees, and wife Stephanie Lane cut the ribbon Sept. 22 on computational biology's new suite of offices in the Hillman Center for Future-Generation Technologies.

➤ By Jason Togyer and Byron Spice

The newest department in the School of Computer Science has already made great strides in analyzing the biological processes that control diseases such as diabetes and asthma and identifying more than 100 genes that are potential targets for new cancer therapies.

In September, the two-year-old Ray and Stephanie Lane Center for Computational Biology became the first degree-granting program in computational biology to be included within a computer science school.

It joins the Computer Science Department, Robotics Institute, Human-Computer Interaction Institute, Machine Learning Department, Language Technologies Institute and the Institute for Software Research as SCS's seventh academic unit.

Achieving departmental status is a powerful "statement of confidence" that Carnegie Mellon "recognizes and values computational biology as a discipline," says Bob Murphy, the university's Lane Professor of Computational Biology and the first head of the newly created department. "And that's different from many

other places, where comp bio is included in a biology department or a medical school. Our program is different from many of those by having a higher level of computational rigor."

Also importantly, becoming an academic department allows the Lane Center to recruit permanent tenure-track faculty, Murphy says. Until now, Lane Center affiliates have had primary appointments in other departments, which has caused faculty to feel torn between doing work in their home programs and in computational biology. That tension will be alleviated, Murphy says, when the department starts appointing its own faculty, within the next year.

The center was created in 2007 with the help of a \$5 million gift from former Oracle chief executive officer Ray Lane and his wife, Stephanie. At the time, Lane says, the couple felt Carnegie Mellon's computational and imaging capabilities held great promise to advance medical research. "The scientific progress we've seen since then has only underscored this belief," says Lane, chair of the university's board of trustees and a managing partner of the investment firm Kleiner, Perkins, Caufield and Byers.

The shift to department status also reflects the ongoing evolution of computational biology as a field, says Murphy, who in 1987 helped create the university's original undergraduate program in computational biology in the Mellon College of Science. (It's now a joint program between SCS and MCS, and in 1999, a master's degree was added.)

"There was optimism when the field began that if we threw a lot of computing power at biology, its problems would be solved," Murphy says. Instead, entirely new sets of problems have been created that are neither computer science nor biological science—they're specific to computational biology.

"That's exactly how interdisciplinary fields are supposed to work," says Murphy, comparing it to the evolution of biochemistry as a unique discipline, separate from either pure biology or chemistry, in the mid-20th century. "They often retain that collaborative character, but they also develop their own unique character."

The Lane Center's elevation comes after a summer in which researchers reported several milestones that could have far-reaching implications. In June, for instance, a team led by Ziv Bar-Joseph reported that gene regulatory networks in cell nuclei are similar to cloud computing networks. (See "SCS in the News," *The Link*, Summer 2009.) In August, another Lane Center team—led by Eric Xing, an associate professor of machine learning, language technologies and computer science—developed a statistical technique for detecting the genetic variations that contribute to complex diseases such as diabetes, asthma and cancer.

Rather than searching one at a time for genetic alterations that cause a particular symptom or trait—the conventional approach—Xing's group used a graph-guided fused lasso method to look for combinations of genetic markers, medical symptoms and environmental factors that were strongly linked to certain diseases. Severe asthma, for instance, is characterized by more than 50 clinical traits, some related to environment or activity levels, but others to symptoms such as wheezing and tightness of the chest, and still others to lung physiology.

In one test, Xing's team successfully detected a gene variant already implicated in severe asthma and then identified two additional variants that had not previously been associated with the condition.

"This approach will provide a more comprehensive genetic and molecular view of complex diseases so we can identify the genes that underlie disease processes, understand the role of genes in determining the severity of disease and develop improved methods for diagnosing disease," says Xing, who reported the group's findings in the August 14 issue of *PLoS Genetics*, along with post-doctoral scientist Seyoung Kim.

The Lane Center's most important external partnership is with the University of Pittsburgh, which along with Carnegie Mellon runs a joint doctoral degree program in computational biology. (The degrees are conferred by the individual institutions.) The connection with the University of Pittsburgh Medical Center provides Ph.D. candidates with relevant expertise, avenues for data collection and "clinically relevant" problems to work on, Murphy says.

The Lane Center is actively recruiting faculty members and discussions are also underway on the direction of the joint MCS-SCS undergraduate and master's programs in computational biology.

A major focus of current and planned research by Lane Center faculty is the development of advanced machine-learning methods for understanding how complex biological systems work. The number of variables involved in biological systems makes it impossible to build models of those systems by doing experiments for every possible combination of those variables, Murphy says. That's where the machine-learning method called "active learning" becomes necessary. Active learning builds models using the currently available data, then chooses the best experiments to perform in order to optimally use those models.

According to Murphy, it represents a whole new way of designing experiments: "With active learning, the design of an experiment isn't necessarily based on a hypothesis or the intuition of the experimenter, but on the model that's been created and the data that's been acquired so far."

As a result of automated learning techniques, "the Lane Center hopes to play a catalytic role in changing how biological research is done," Murphy says. "That's something we recognize is central to the university's interests, and it will have a lasting place here."

Found in Translation

InterACT helps change science fiction to science fact

> By Karen Hoffmann

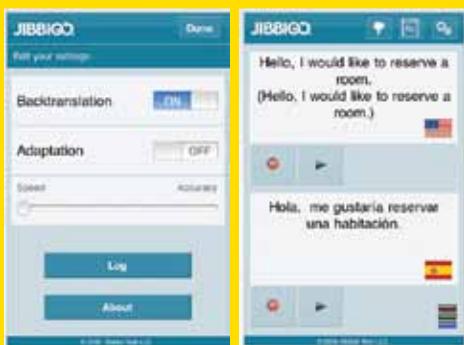
The Thai toddler cries and cries. Her father doesn't speak any English, and the visiting American doctor barely knows a word of Thai. Still, the doctor asks, "What's wrong?" A rugged laptop computer translates and speaks the Thai words. The girl's father answers, "Her stomach hurts," and the computer repeats it in English. In this way, the doctor is able to diagnose and treat the girl's pain.

In a boardroom of a major company in Europe, four people enter. Each speaks a different language and they wouldn't ordinarily be able to understand each other. Cameras on the wall recognize each person and track where they sit. Then, individualized audio translations of what others are saying are beamed to them without wires or headsets so that only they can hear.

In situations like these and many others, technology developed at the International Center for Advanced Communication Technologies is changing lives. InterACT is a partnership between Carnegie Mellon and several international universities. Under the direction of Alex Waibel, professor in CMU's Language Technologies Institute, it's developing software that translates, in real time, spoken English, Spanish, German and Japanese.

InterACT scientists started out translating broadcast news, then moved to speeches and lectures. In October, a start-up company founded by Waibel rolled out an iPhone app, called Jibbiggo, which translates live conversations between English and Spanish. "We've been working on this technology since 1987, and this is the first time we've come out with something everybody can use," says Waibel, who also has an appointment as a professor of computer science at Universität Karlsruhe in Germany. "I'm just ecstatic."

The progress being made toward a Star Trek-style "universal translator" is the product of years of work dating back to the early 1990s, when InterACT created its first speech translation device. Instead of trying to train computers to learn the rules and idiosyncrasies of various languages, InterACT uses statistical analysis. Researchers transcribe



Jibbigo, a translation app for iPhones, is a spinoff from interACT research.

lengthy sound files into text, then feed both the audio and the text through a series of algorithms. The translation software learns to associate certain sounds with certain text patterns—and the more data used to train the software, the better the translations become.

News and political speeches proved relatively simple to translate because they tended to follow a set pattern and proceed smoothly, Waibel says. But developing Lecture Translator, which debuted in 2005, presented more of a challenge. Lecturers were prone to stuttering, vocalizing their pauses (saying “um” and “ah”) and making false starts in their sentences. Plus, the vocabulary needed to translate lectures on thermodynamics, for instance, was very different from that of everyday speech, or even from lectures on other topics such as philosophy.

Waibel’s group jumped those technical hurdles by making their translators adaptable to specialized vocabularies. Now, a lecturer can input her text before she begins speaking. Lecture Translator goes online and searches out the meanings of any unfamiliar words, along with terms related to those words. During the lecture, the recognition algorithms run with this modified vocabulary. As a professor lectures in English, her words and a real-time Spanish translation of them are shown on the screen behind her. German is also in the works.

Another technology developed at interACT uses highly directional loudspeakers—sort of “acoustic laser beams”—to whisper translation to individual people in a room. Waibel says it’s like getting a personalized translation at the United Nations General Assembly, but without wearing a big, clunky headset.

The most difficult arena to translate, so far, has been that bane of many people’s existence—the meeting. “Meetings and phone conversations are particularly nasty because they are particularly

disfluent,” Waibel says. People interrupt each other, for example. “The whole vision we’re trying to realize is building a conference room where we could all sit in our respective chairs, talk in our respective languages and hear our respective languages,” Waibel says. “My life’s dream is to realize that. With targeted audio and simultaneous translation capability you can feel that this would be possible.”

InterACT also brings its technology out of the conference room and into the field. The Jibbigo app, which costs \$25, is unique among translation applications in that it runs locally on the iPhone and doesn’t require an Internet connection. (The name comes from “gibberish” and the Japanese suffix “-go,” meaning language.) At a lecture in October, Waibel showed video of Jibbigo being used to help doctors communicate with patients at a clinic in Honduras. Even in the United States, many hospitals and clinics aren’t equipped to deal with people who don’t speak English. Waibel’s team provides their Spanish translation technology to Pittsburgh’s East Liberty Family Health Care Center, which treats people without health insurance.

In the spring, Waibel and graduate student Matthias Eck attended the annual two-week Cobra Gold joint military exercise between the United States government and various Southeast Asian nations. Every day, they were up at 5 a.m. to travel with American doctors to remote villages in Thailand, bringing along their technology to help

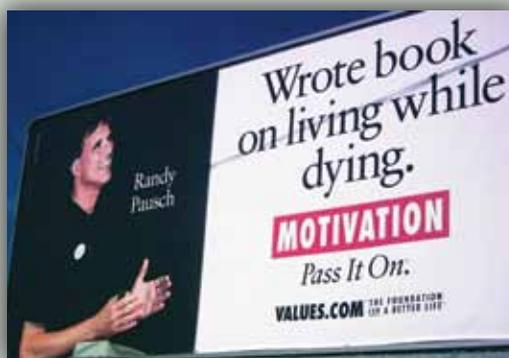
patients vocalize their needs. These and other field exercises provided real-world tests far more severe than anything that researchers could concoct in a lab, Waibel says. “You’re there with a laptop and dealing with everything from (speech and translation) algorithms, to ‘how do you confront a Thai farmer with a microphone and explain he has to speak at the beep?’ And in the background your noise problems consist of chickens squawking!”

In the end, says Waibel, the goal is to create flexible technology that’s adaptable to local situations. “We can’t possibly, in the lab, adapt it for every language or dialect situation; things will always have to be done locally,” he says. “We need to build technology that is simple enough to be maintained by people themselves, so that someone in the field can put a word into the system themselves.”

Waibel notes that he’s not trying to replace human translators; they’re particularly useful in diplomatic situations, where they can provide context and calm people down. Instead, he’s interested in helping in situations where the choice isn’t between human and machine translation—it’s a question of using a machine or getting no communication at all. “The older I get, the more helping people becomes important to me,” Waibel says. “It’s less about having the latest widget and more about actually touching people’s lives.”

Karen Hoffmann (S’04) is a freelance writer who frequently covers science and technology. She interviewed Maxine Eskenazi for the Spring 2009 issue of *The Link*. For more information on InterACT, visit www.is.cs.cmu.edu.

Sign of Hope



Thomas Edison, Albert Einstein, Abraham Lincoln, Mother Teresa and Desmond Tutu.

On Oct. 30, Carnegie Mellon cut the ribbon on the new Randy Pausch Memorial Bridge, which connects the Gates Center for Computer Science with the Purnell Center for the Arts. We have photos of the dedication ceremony on our Web site, link.cs.cmu.edu.

More than a year after Randy Pausch’s death from complications related to pancreatic cancer, the message of his “Last Lecture” is continuing to motivate people.

The non-profit, non-partisan Foundation for a Better Life, founded in 2000 by Colorado philanthropist Philip Anschutz, is using Pausch (CS’88) as part of an award-winning national billboard campaign for its Values.com Web site. Other personalities being used in the campaign include Muhammad Ali, Neil Armstrong,

Faculty, staff and students have made the big move to the Gates and Hillman centers—and may yet learn to love the Helix

KEN ANDREYO PHOTOS / DAVID COULSON ART



The circular ramp, or “Helix,” that connects the third through fifth floors of the Gates Center is a signature feature of the building. CMU President Jared Cohon says the bare concrete was brought over from Wean Hall so that SCS personnel wouldn’t get homesick.

We're In!

A series of cartoon illustrations are placed around the text. On the left, a boy in a yellow shirt sits on the ground reading a red book labeled 'MATH'. In the center, a boy in a yellow shirt is on a skateboard, with a dashed line indicating his path. To the right of the skateboarder, a woman in a blue suit and a man in a blue suit stand together. On the far right, a boy in a yellow shirt waves his hand.

> By Jason Togyer

They like the collaborative spaces. They like the comfy chairs. They like all the windows and the internal views and the sixth-floor patio, which turns out to be a pretty neat place from which to watch fireworks shot off elsewhere in Pittsburgh.

Yet after four months in the Gates Center for Computer Science, people still aren't sure they like that Helix.

It's the signature feature of the building—a gently sloping circular ramp connecting the third through fifth floors—but for Carnegie Mellon students used to dashing from place-to-place, it's just not quick enough.

"It's somewhat baffling to me, since it seems like a pretty inefficient way of getting people between floors," says Elly Jones, a senior in the School of Computer Science. Sophomore Samantha Catanzaro has actually timed the walk: "It takes me two minutes to get to a class in the middle of the Helix from the time that I see it," she says. (Your editor timed it, too. Even walking briskly in his size-12 wingtips, it's at least 90 seconds between the two classrooms in the Helix.)

"It looks cool and I like the concept, but it is a sort of long way to go up one floor," adds Victor Marmol, a CS junior. (It measures about 110 paces, give or take a wingtip.)

If it's any consolation, even the building's namesake was a bit unclear on the purpose of the Helix at first. A gift of \$20 million from the Bill and Melinda Gates Foundation helped make the Gates Center possible. When Bill Gates first

saw the blueprints, he said at the Sept. 22 dedication ceremony, "there was this big squiggle in the center of the plans, and I didn't know what it was. I almost said, 'Get rid of this squiggle!' But now I find out, it's actually valuable."

Indeed it is, says Owen Durni, a CS senior: "It seems a bit odd at first, but having space around the center of the building lets a lot more natural light in."

A few students have also found other things to like about the Helix, though not necessarily what Atlanta-based Mack Scogin Merrill Elam Architects intended. According to reliable reports, mountain bikes have already made the trip, and a definitely unsanctioned, unauthorized, unsafe and unwise gravity-propelled rolling office chair race was held one Saturday night. (Students are clearly testing their boundaries. A few undergraduates have politely but firmly been told to "go home and go to sleep" after getting a little too comfortable in the funky, amorphous chairs that dot the lounge areas. Taking a quick catnap is one thing, one faculty member told us, but bringing a pillow and a blanket is a bit much.)

Learning to love the Helix and getting comfortable (maybe too comfortable) inside the buildings are the surest signs that occupants are embracing the Gates Center and the neighboring Hillman Center for Future-Generation Technologies. Since moving into the \$98.6 million complex in August, they've gone through stages such as wonder ("is all this ours?") and frustration ("why isn't the ventilation system working right?") and discovery ("have you seen the 'Hogwarts' staircase in Hillman?"). And though they've been living and working for two months in the School of Computer Science's new 217,000-square-foot,



KEN ANDREYO PHOTOS

Students and faculty alike appreciate the well-lit collaborative work spaces located on every floor of the Gates and Hillman centers. One CS undergrad says "working there during sunset is amazing."

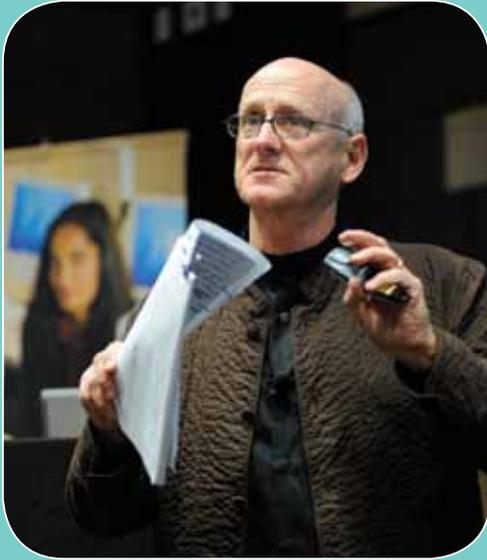
5.6-acre complex, a few people are still occasionally bouncing off of glass doors and walls like sparrows stunned by picture windows. (Ouch.)

The most unusual feature Catanzaro's noticed are chairs in public areas that have vertical slots cut in the back. It's like they're designed "to accommodate people with tails," she says. (Well, Pittsburgh has hosted the annual "Anthrocon" science fiction and fantasy convention for the past three years, so we've seen a few people walking around town with tails. But we're told that the chairs—made by the Italian company Moroso—are actually designed to better mold themselves to the human back and spine.)

Four SCS units—the Computer Science Department, the Machine Learning Department, the Language Technologies Institute and the Lane Center for Computational Biology—are now headquartered in the Gates and Hillman centers. Their relocation gave additional room to grow to SCS's other three departments—the Robotics Institute, the Human-Computer Interaction Institute and the Institute for Software Research. (Internal shifts were literally underway before all of the paint was dry in Gates and Hillman, with the Quality of Life Technology Center >>>

Pittsburgh philanthropist Henry Hillman, wife Elsie and Microsoft co-founder Bill Gates share a laugh during the dedication ceremonies for the Gates and Hillman centers. Henry Hillman, born in 1919, joked that he wanted to be surgically attached to Gates' hip, much like the two buildings are joined by a glass-enclosed passageway.





Architect Mack Scogin channels Henry Hornbostel: “This ultra-modern architecture is the stuff for me.”



Computer science professor Guy Blelloch led the committee that set the specifications for the Gates and Hillman centers.

“These buildings and the School of Computer Science are going to be a tremendous benefit to Carnegie Mellon, Pittsburgh and the nation for decades.”

Henry Hillman

relocating to space in Newell-Simon Hall once occupied by LTI, and ISR’s faculty and students spreading out on the fourth and fifth floors of Wean Hall.)

Coordinated by SCS Director of Building Facilities Jim Skees and his staff, the move went smoothly, though not without a few hitches. A terabyte of research data went astray for several anxious days, a supplier ran short on promised whiteboards, and—in a spirited embrace of an old Carnegie Mellon tradition—painting, carpeting and landscaping crews pulled several all-nighters before the Sept. 22 dedication ceremonies. One of the building’s crucial “connections,” the Randy Pausch Memorial Bridge linking the Gates Center to the Purnell Center for the Arts, wasn’t available at first, but was completed in time for Carnegie Mellon’s Homecoming Weekend in October.

The bridge was formally opened Oct. 30 at a ceremony attended by Pausch’s wife, Jai, and his children, Dylan, Logan and Chloe, who cut the ribbon and then ran joyfully squealing from Purnell to Gates.

The buildings were formally dedicated the same week as the leaders of the “Group of 20” nations met in Pittsburgh for a worldwide economic summit. The coincidental timing wasn’t lost on

Pittsburgh philanthropist and industrialist Henry Hillman, whose gift of \$10 million helped speed the Hillman Center to completion.

“The G-20 summit is going to be a real benefit to Pittsburgh for a few days,” Hillman said before the ribbon cutting. “But these buildings and the School of Computer Science are going to be a tremendous benefit to Carnegie Mellon, Pittsburgh and the nation for decades.”

Hillman, who was born in 1919 near what was then a small, regional college called Carnegie Institute of Technology, said the new buildings represent a personal milestone for him as well. “When I was a little boy, we lived about 1,000 yards from the campus,” he said. “Then, when my wife Elsie and I got married, we lived on Devon Road, about 500 yards from the campus. Now, our property is literally two yards from the campus. If you were to extrapolate those data points, within

three years, Elsie and I are going to be living in (CMU President) Jerry Cohon’s office.”

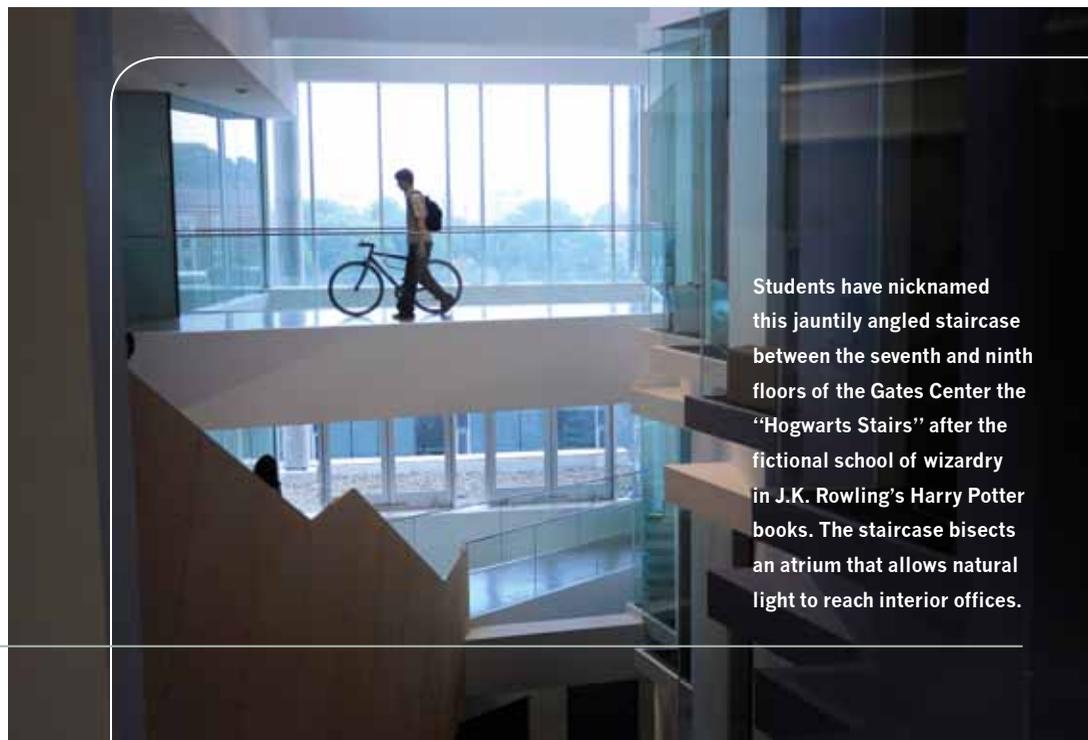
Besides providing 310 offices, 10 classrooms and 13 public meeting spaces, the Gates and Hillman centers have created something else that’s a little bit startling the first time it’s seen. There’s now a whole new pedestrian “mall” perpendicular to the Cut, with landscaping designed by Michael Van Valkenburgh Associates of Brooklyn, N.Y.

One visitor touring the Gates Center before the dedication ceremony gasped, “Oh! It’s a real campus now!” when looking at the view from the eighth floor. What was once a group of separate buildings floating in a sea of parking lots—Newell-Simon Hall, the Collaborative Innovation Center and the old U.S. Bureau of Mines complex (the university’s Smith and Hamburg halls)—are now connected via a wide, tree-lined walkway to the Kraus Winter Garden.

Nestled between the Gates and Hillman centers, the Winter Garden is just one of the green spaces built into the complex. In fact, with apologies to Kermit the Frog, it turns out that it is easy being green, at least when it comes to the construction of the new SCS buildings. It seems counterintuitive, but the construction of these two massive new buildings actually added more than 60,000 square feet of new green space to the campus, thanks to plantings on three roofs and the replacement of a surface parking lot with an underground garage covered in turf.

Parts of the greenery may look a little “weedy” for some people’s tastes, says Eric French, a certified horticulturist for Eisler Landscaping of Butler County, Pa., north of Pittsburgh, which cultivated many of the grasses and shrubs now adorning the SCS complex. The green roof on the fifth floor, for instance, “is a meadow, and it’s going to do meadow-y things,” he says. Many of the plants, like sumacs and berry bushes, are native to Western Pennsylvania and should require >>>

Continued on page 12



Students have nicknamed this jauntily angled staircase between the seventh and ninth floors of the Gates Center the “Hogwarts Stairs” after the fictional school of wizardry in J.K. Rowling’s Harry Potter books. The staircase bisects an atrium that allows natural light to reach interior offices.

What's in a Name?

The generosity of alumni, faculty, staff, students and friends of SCS has contributed millions of dollars toward the completion of the Gates Center for Computer Science and the Hillman Center for Future-Generation Technologies. The former was completed with the support of a \$20 million gift from the Bill & Melinda Gates Foundation, while the latter received a \$10 million donation from the Henry L. Hillman Foundation. In addition, more than 100 seats in the Rashid Auditorium have been named. Here are some of the named spaces inside the new SCS complex, along with the identity of their namesakes or principal donors, where appropriate.



Yumi Iwasaki (CS'88) and Anoop Gupta (CS'82,'86) prepare to cut the ribbon on Room 4215. The Gupta-Iwasaki Classroom is one of the many "named spaces" in the Gates Center and Hillman Center that honor donors or other friends of SCS.

The Lehman Family Office, Room 5109: Gift of Jill Fain Lehman (CS'87,'89) and Philip L. Lehman (CS'78,'84)

Gordon Bell Conference Room, 5117: Gift of Gordon Bell and the Bell Family Foundation, named for Gordon Bell, CS faculty member from 1966 to 1972, former vice president of engineering at Digital Equipment, and currently principal researcher in Microsoft's Silicon Valley Research Laboratory.

Red Hat Computer Laboratory, Room 5205: Gift of Red Hat Inc.

Siewiorek-Walker Classroom, 5205: Gift of Karon Walker Siewiorek and Daniel P. Siewiorek

Remala Family Classroom, 5222: Gift of Satya and Rao Remala Foundation and Srilakshmi D. Remala (HS'02)

Gates Center, Sixth Floor

Asian Student Association Conference Room, 6115: Gift of anonymous donor

Eric and Melissa Daimler Collaboration Office, Room 6217: Gift of Melissa J. and Eric A. (HS'94) Daimler

Hillman Center, Sixth Floor

Traffic 21 Conference Room, 6501: Gift of Hillman Foundation and Henry L. Hillman Foundation

Gates Center, Seventh Floor

Mach Project Room, 7114: Gift of David L. Black (CS'88,'90), named for Mach operating system kernel developed at SCS

Hillman Center, Seventh Floor

Ray and Stephanie Lane Center for Computational Biology Suite: Gift of Stephanie H. and Raymond J. Lane, Life Trustee

Gates Center, Eighth Floor

Blelloch-Skees Conference Room, 8115: Named for Guy Blelloch, professor of computer science, and James Skees, SCS director of building facilities, in honor of their efforts toward completion of the Gates and Hillman centers

For more information, please contact scsgiving@cs.cmu.edu

Outside Third Floor

Kraus Winter Garden: Gift of Life Trustee Jill Gansman Kraus (CFA'74) and Peter Kraus

Gates Center, Third Floor

R-Bar Café: Gift of Sharon L. Rohr and James E. Rohr, Life Trustee

Weidinger Family Interactive Robot: Gift of Amy and Rick Weidinger

Red Hat Computer Laboratory (inside 3000): Gift of Red Hat Inc.

Gates Center, Fourth Floor

Luis von Ahn Awesome Classroom, 4101: Gift of Luis Alfonso von Ahn (CS'03,'05) and Laura Dabbish (CS'05,'06)

Zimbra Classroom, 4102 (inside Helix): Gift of Kate Sandrini and Scott Dietzen (S'84, CS'92), named for his open-source groupware collaboration company

The Maeda Office, Room 4103: Gift of Chris Maeda (CS'92,'97)

SCS Alumni Advisory Board Offices, 4122-4126: Gift of SCS Alumni Advisory Board members

Gupta-Iwasaki Classroom, Room 4215: Gift of Yumi Iwasaki (CS'88) and Anoop Gupta (CS'82,'86)

McWilliams Center eScience Video Facility, Room 4303: Gift of Astrid McWilliams and Bruce M. McWilliams (S'78,'81), Trustee

Hillman Center, Fourth Floor

Rashid Auditorium, Room 4401: Gift of Terri and Rick Rashid

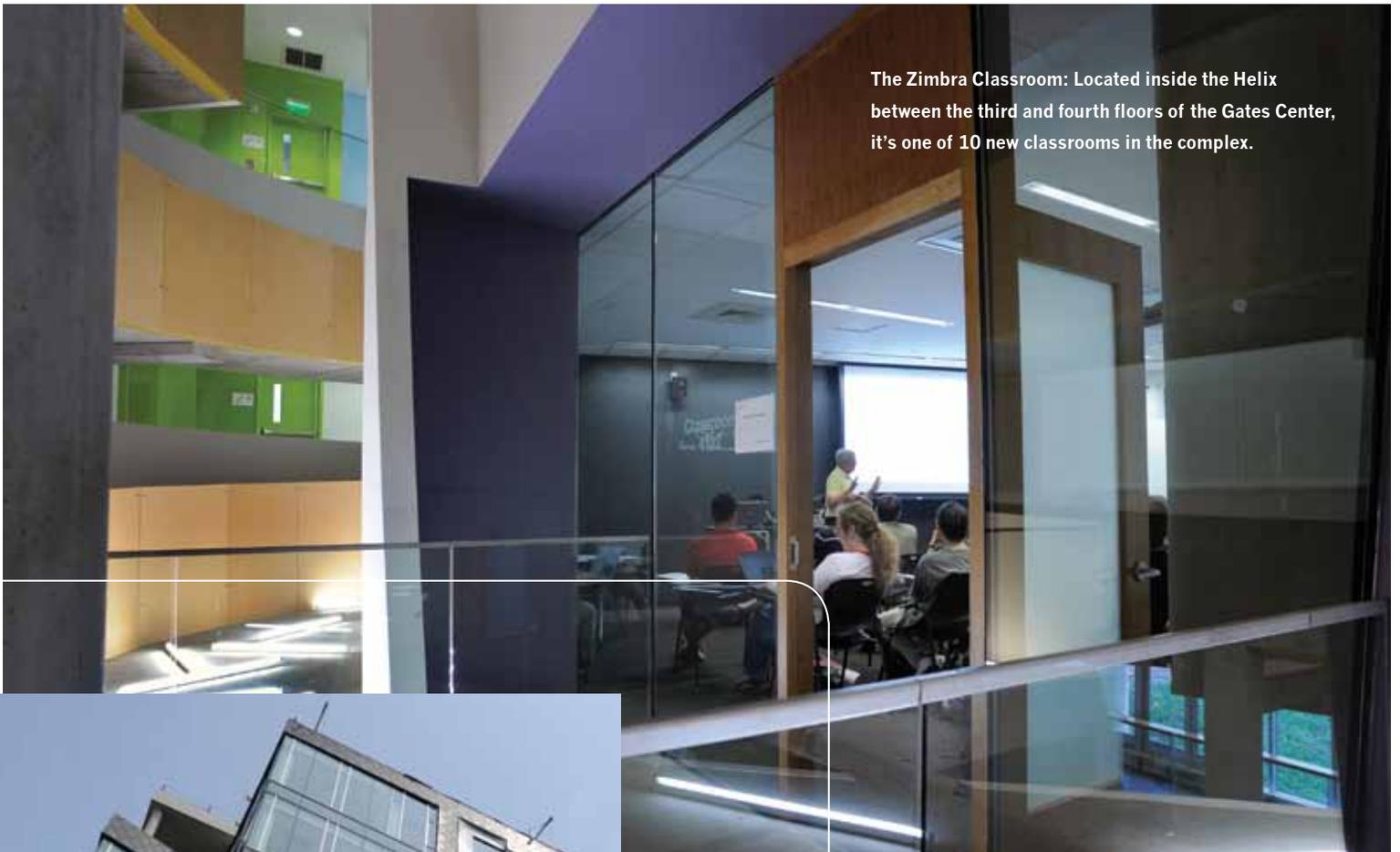
Raj Reddy Conference Room, 4405: Gift of Donna Blyshak and Alejandro Acero (E'90), Holly and Fileno A. (S'80) Alleva, Marsha and Ralph J. (HS'74, CS'79) Guggenheim, Hsiao-Wuen Hon (CS'92), Yingzhi (HNZ'92) and Xuedong Huang, Elaine A. Rich (CS'79) and Alan Cline, Ilana Diamond and Roni Rosenfeld (CS'91,'94), Julie V. and Michael I. Shamos, Ann Gibbons Scherlis and William Scherlis, and Ka Yan Chan and Heung-Yeung Shum (CS'96); named for former SCS Dean Raj Reddy

Gates Center, Fifth Floor

Randy Pausch Memorial Bridge

Microsoft Alumni Outdoor Classroom (next to Pausch Bridge): Gift of Arnold Blinn (CS'87), Kurt A. Geisel (HS'92), Jay P. Kapur (E'00) and Derek Leung (CS'04)

Fisher Coffee Alcove, Room 5009: Gift of Eden L. Fisher (E'84) and Allan L. Fisher (CS'81,'85)



The Zimbra Classroom: Located inside the Helix between the third and fourth floors of the Gates Center, it's one of 10 new classrooms in the complex.



Exterior of the new Gates Center

Continued from page 10

“almost zero maintenance,” French says. Rain-water and snowmelt are captured and reused in a “drip irrigation” system to feed the plantings.

But how are the buildings as a working environment? “Stunning,” says Marmol, who loves the collaborative spaces. “On the upper floors—seven, eight and nine—there are these work areas next to the windows that have a ton of sunlight, and working there during sunset is quite amazing.” Adds another CS junior, Kenechi Ufodu, the buildings “make a statement as to how collaborative the environment is around here.”

Jones, who works in the 15-412 lab on the sixth floor, says just having natural light in her working environment makes her feel happier. “The whiteboard walls are fantastic,” she says. “Our whiteboard wall is actually fogged glass, which is really neat.”

All of this is music to Guy Belloch’s ears. A computer science professor, he was named five

years ago by SCS Dean Randy Bryant to chair the faculty committee overseeing the design of the buildings. (“I didn’t really know what I was getting into,” Belloch says. “I think he appointed me because I kept complaining that we needed a new building.”)

Throughout the design process, Belloch says,

committee members kept trying to think about “big ideas” instead of just planning “another building.” “We really wanted the buildings to promote collaboration,” he says. “We wanted them to be a friendly place where people would want to work, rather than working from home. And that included potential students and faculty members—we wanted them to want to come here.”

A thousand little telling details bear the committee’s imprint. For instance, because SCS has traditionally encouraged an “open door policy,” doors in the Gates and Hillman centers are extra-wide—four feet instead of the typical three. “They look a little funny,” Belloch admits, “but they help provide visual connectivity as you walk through the building—you can see into classrooms, offices, conference rooms.”

Thanks to all of that “visual connectivity,” Belloch says he’s able to see into the offices of colleagues and fellow committee members

Manuela Veloso and Carlos Guestrin, and he finds himself calling them on the phone while he watches them through the windows. “We call it ‘low-resolution Skype,’” he says.

If the buildings work as intended, says architect Scogin, they’ll “bring people together in a collective condition” while still allowing individual creativity to thrive. During the Sept. 22 celebration, about 200 people in the new Rashid Auditorium watched in rapt fascination as Scogin took them on a whirlwind tour of his firm’s creative process and the history of architecture in Pittsburgh and at Carnegie Mellon.

Scogin showed how the unusual zinc exterior panels of the Gates and Hillman centers echo forms found on the buildings of Henry Hornbostel’s original Carnegie Tech campus, and on other local landmarks, such as the former Alcoa Building—now the Regional Enterprise Tower—that’s been a fixture of Pittsburgh’s Golden Triangle since 1953.

A great admirer of Hornbostel, Scogin quoted him as saying “this ultra-modern architecture is the stuff for me.” Only time will tell if Scogin’s structures stand up to scrutiny as well as Hornbostel’s, but for now, the ultra-modern architecture of the Gates and Hillman centers—Helix and all—seems to be “the stuff” for the School of Computer Science, too.

Jason Togyer (HS’96) is managing editor of *The Link*. He’s in Gates 5013, just west of the Helix, where he has a box seat for watching office chair races. Email him at jt3y@cs.cmu.edu.

Sara Kiesler



Sara Kiesler and Moe

Why a “Snackbot”? Why not some other kind of robot?

Jodi Forlizzi and Paul Rybski wanted a robot that would deliver a service, so we decided to work on the idea that Snackbot would dispense snacks and encourage healthy snacking. We didn't have the resources to build a real humanoid robot—Snackbot doesn't even have “arms”—but it gives the impression of one. The head, the mouth that smiles—we've been studying the things that make robots seem human-like. One of my contributions has been research into people's mental models of what they think is going on behind the machine.

Does that include managing people's expectations?

Yes, their expectations are very high, even with Snackbot. Snackbot is actually very, very simple, but if a robot can speak, people imagine it can think. If you tell people a robot was built in China, for instance, they assume it knows about the Great Wall of China. They overgeneralize.

People make these assumptions based on very small amounts of information. The robot itself is like an inkblot—they impute characteristics to the robot. This can create feelings of disappointment and confusion when the robot doesn't behave the way they think it should. Even some robotics students do it, which is amazing to me.

Sara Kiesler is the university's Hillman Professor of Computer Science and Human-Computer Interaction. She came to Carnegie Mellon in 1979 as a professor in the Department of Social and Decision Sciences and conducted some of the first scientific studies of computer-mediated communication and the Internet.

A graduate of Boston's Simmons College, she earned masters' degrees in psychology and communication at Stanford and a doctorate in psychology at Ohio State.

Kiesler spoke to Link Managing Editor Jason Togyer about her current research, which includes the Project on People and Robots, an interdisciplinary initiative funded by the National Science Foundation, Microsoft and Pittsburgh's Hillman Foundation.

One offshoot of the Project on People and Robots has been Snackbot, which debuted at the dedication ceremonies for the Gates and Hillman centers.

Do people assume robots are smarter than they really are?

Actually, you can apply some of the same ways that people think about dogs to their mental models of robots. In my spare time, I train dogs, and I'm always amazed when I show people what dogs can and can't do. They come home and there's garbage on the floor and they think, “Oh, my dog was mad at me, because I was late.” They think the dog can feel resentment or revenge. But dogs don't understand causal connections in the same way we do. In the same way people impute characteristics to their dogs, people impute characteristics to robots.

Are people reluctant to interact with a robot?

Not necessarily, and in fact we can learn about people from the way that they interact with robots. One of my former students, Cristen Torrey, studied robots designed to help people. Sometimes people don't want to be helped by a robot because it seems demeaning. It turns out that people are more accepting of a robot's help if it hesitates a little bit and is less directive. It seems strange for a machine to act that way, but it might work when we're designing robots in the future that are designed to act as caretakers.

We're learning that we can do a better job building those kinds of robots, even with very minimal designs.

Your other research has been into online collaboration—is “crowd-sourcing” a model for distributing other kinds of work besides software?

Software collaboration works better than other types of online collaboration because it can be modularized. Otherwise, distributed research doesn't necessarily work very well. We recently did a study for the National Science Foundation

to examine the outcomes of a program they had in distributed research, and we found that the more universities that were involved in a project, the less likely it was that the project was productive.

One of the stumbling blocks was coordinating meetings. In a distributed project, we might have to make appointments to meet—we can't just depend on running into each other in the hallway. Another problem is that people don't have situational awareness of what their colleagues are working on, or what problems they're having. When people lose touch with colleagues, they start working on local problems and the research is more apt to become fragmented and uncoordinated.

Does that mean the Internet is an impediment to collaboration?

No, the Internet has made it possible to form distributed collaborations. There are online communities of researchers that are very strong, and wouldn't exist if they couldn't be online. But you can't just impose the old organizational structures.

That's why I want to understand the ways technology and changes in the way we do work can support collaboration. What kinds of newer technologies are there to support organizations—and what's going to have to be done differently when we're forming organizations in the future?

There are people at other places who design wonderful technologies and then find uses for them—that's not for me. I still believe in studying people and organizations first, and then designing systems to support them.

Agents of Change



Eduardo Miranda, associate teaching professor in the Institute for Software Research, instructs a software engineering class both for students in Pittsburgh and for students collaborating online from the University of Coimbra in Portugal, who participate via a camera and monitor at the back of the room.

For 20 years, the Master of Software Engineering Program has produced professionals who make an impact in their companies and the world

> By Jennifer Bails

Producing “agents of change” sounds more like a political catchphrase than anything to do with computer science.

But for the past two decades, that’s exactly what Carnegie Mellon’s groundbreaking Master of Software Engineering program has been doing—cultivating future leaders in the discipline of software engineering by preparing them to be agents of change in their industry.

“We often use the phrase ‘agents of change’ because we want people to come here and then return to their organizations and change the way software engineering is done,” says David Garlan, professor of computer science and director of MSE professional programs. “The intent has always been to positively impact software engineering practice, and our students view their experience while in the program as a transformational one.”

Founded as a joint effort between SCS and the Software Engineering Institute, the MSE program celebrates its 20th anniversary March 12 and 13. More than 200 graduates of the program will return to Pittsburgh for a two-day celebration.

“This is a wonderful opportunity to celebrate the evolution of our program in the past 20 years, and to celebrate all of the graduates whom we’ve put into important places and who have gone on to be successful in their own right,” says longtime MSE faculty member Mary Shaw, the Alan J. Perlis Professor of Computer Science.

The reunions will follow the 23rd International Conference on Software Engineering Education and Training—the premier annual conference in software engineering education—being held one week earlier on the Carnegie Mellon campus. “We had an alumni reunion workshop five years ago where people came back to give talks about their work and share their experiences,” Garlan says. “We want to do that again, but make the event even bigger this time around.”

Thinking big has always been integral to the mission of the MSE program, an intensive 16-month curriculum for early- to mid-career software development professionals. Incoming class size generally numbers about 30 students, who average five years’ industry experience and have strong potential for leadership in the opinions of their employers. These are students already on the front lines of software development, dissatisfied with the status quo and eager to learn better ways of doing their jobs.

Bob Lindman (CS’00) and three co-workers from Michigan-based auto parts maker Delphi Corp. were enrolled with the company’s sponsorship after working in software development for several years. “They sent us to Pittsburgh because they were looking to train people who could really engineer a solution, rather than just write code,” he says.

The program was created in 1989 by SEI founder Angel Jordan—now emeritus university professor of electrical and computer engineering and robotics—and the late Nico Habermann and Norman Gibbs. At the time, Garlan says, there weren’t any similar academic degree tracks for software engineering professionals anywhere in the country.

From those early days, the small but high-impact MSE program has helped set the standard for software engineering education. A panel of some of

the field’s leaders, organized by the Forum for Advancing Software Engineering Education, recently named the program and its graduate curriculum model as one of the top 10 contributions in the area of software engineering education, training and professional issues. The MSE program and its curriculum “caused considerable attention to be placed on graduate software engineering education,” the panel wrote in making its selection among dozens of nominations.

Garlan says most software engineering curricula are patterned after the software lifecycle model, with instruction in requirements specification, specific design methods, testing and verification.

But does that paradigm give students broad-based problem-solving skills? Garlan says no. It’s not enough just to be taught the latest techniques and tools for software development, he argues. Students also need to learn the underlying models and analysis skills necessary to evaluate these technologies and then quickly adapt the appropriate ones to improve their organization’s products and processes.

Lindman says the MSE program gave him the know-how to choose metrics for a project, record and interpret data, and use those data for continuous process improvement, he says. “Now I can actually predict what we are going to be able to do,” he says. “Before that, I was just taking a wild guess.”

A key message of the MSE program is “plan before you build,” adds Manu Kumar (E’95, CS’97), a graduate and a successful Internet entrepreneur best known for founding SneakerLabs Inc., which developed software and services for Web-based customer interaction.

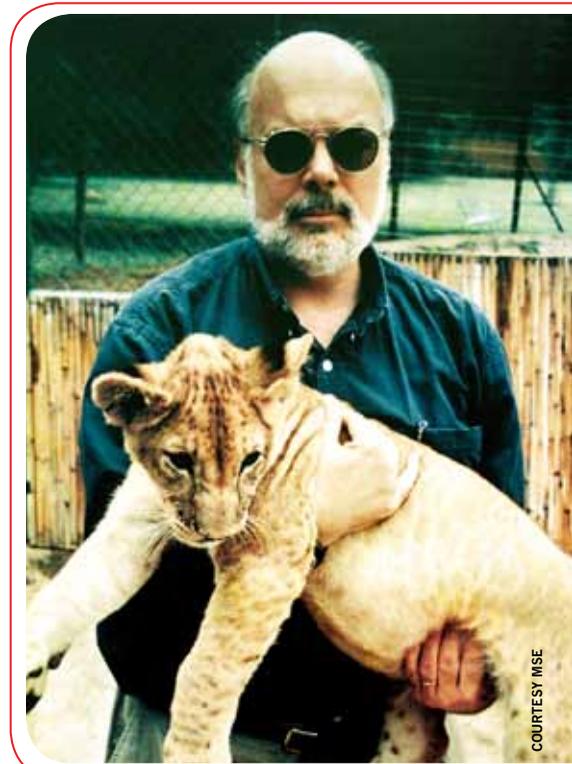
“In the MSE program we didn’t look at code as something that gets thrown together,” says Kumar, whose latest project is K9 Ventures, a venture capital fund that invests in early-stage technology startups in the San Francisco Bay area. “That is a lesson that has been immensely valuable to me in my career. Since I went on to do startups—which operate at a very different pace—I had to adapt the lessons from the program to fit. But the fundamental principles remained the same.”

The MSE curriculum instills these principles through five semester-long core courses that cut across the development process, including analysis of software artifacts, an investigation into the various methods followed, the modeling and

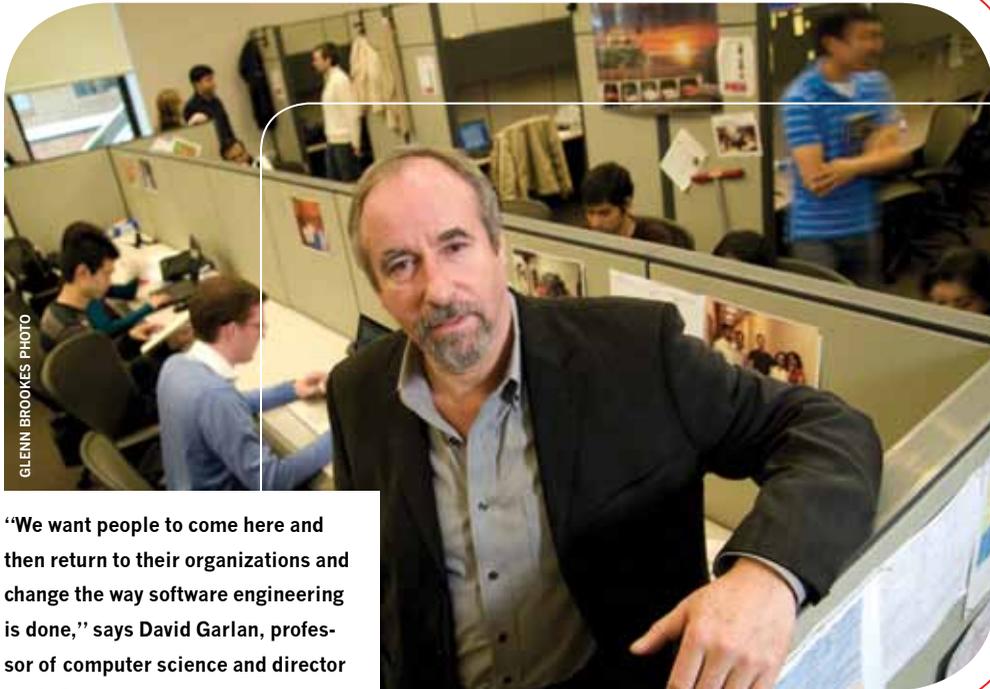
architecture of software systems, and understanding the many factors that go into managing and making product decisions. Through electives, students can concentrate in more specialized areas of software engineering, policy, security, human factors or management.

These meta-level management and analytical skills are critical in the high-stakes field of software development, where shaving a couple of months off a project schedule can save a company thousands of dollars—or where using the right verification methods to test safety-critical embedded systems might save lives.

For instance, Lindman, who now serves as the Delphi technical manager overseeing radios produced for auto giants such as Toyota and Honda, says a client recently expressed displeasure with Delphi’s speed in developing a new in-car entertainment system. “We never seemed to meet our deadlines,” he says. “But by tracking our metrics, we were able to show them that it was the >>>



James E. Tomayko, longtime director of the MSE program, poses with a furry friend during a trip to Africa. Better known as “Coach,” Tomayko (HS’71, ’80) helped found the MSE program at Carnegie Mellon and spent 16 years on the university’s faculty until his death in Jan. 2006 at the age of 56.



GLENN BROOKES PHOTO

“We want people to come here and then return to their organizations and change the way software engineering is done,” says David Garlan, professor of computer science and director of MSE professional programs.

changes they were constantly requesting that caused us to be late.”

The latest advances in software engineering research inform coursework in the MSE program, and are brought into the classroom by faculty who are leaders in their fields. Garlan, for example, is world-renowned for his work in the design of complex software systems at the architectural level. “I’m excited when I can find ways to blend my research interests in software architecture with what is going on in the MSE program,” he says.

The program’s technical emphasis also sets it apart from software engineering professional training at other universities, Shaw says. “We believe that the technical aspects are the primary substance of software engineering, and that management and process activities exist to support them,” she says. “This approach positions our graduates to become senior technical leaders in their companies.”

At the heart of the MSE program is the “Studio project,” a hands-on development laboratory that allows students to apply software engineering practices learned in the core curriculum to real-world situations. Working under the supervision of a faculty mentor, students plan and implement innovative software projects for external clients such as NASA, Westinghouse Electric, Bosch and PPG Industries throughout the duration of the program.

Past MSE students have worked on navigation software and system specification for APEX and semiautonomous robots used to explore the moon and Mars; and helped produce software for the

U.S. Air Force’s B-2 Spirit, or “stealth bomber,” test program.

Beloved MSE program director James Tomayko, who died in 2006, ran The Studio for years, earning the nickname “Coach” from students. He guided them through projects that became their personal laboratories for learning how to put into practice ideas and theories they studied in the classroom. “Jim just really understood how to get students to challenge themselves and start taking responsibility for their own actions and their own engineering decisions,” Garlan says.

The Studio was the most influential part of his experience in the MSE program, says So Norimatsu (CS/IA’96), even if it meant sacrificing sleep and other luxuries during his time in Pittsburgh. “At the time, no other school offered this kind of realistic team-project environment to apply what you learned in the academic classes,” he says. After working for several years as a software developer for a major research institute in Tokyo, Norimatsu came to Carnegie Mellon from his native Japan in 1994 to earn a dual degree in software engineering and industrial administration.

He still applies his Studio training in his current role as an independent consultant advising major multinational corporations based in Japan on how to implement Capability Maturity Model Integration—a software process improvement framework developed at SEI—for better business performance. MSE “taught me a disciplined way to work, where in this case, discipline might mean rigorous engineering, or following an effective management style,” Norimatsu says.

In recent years, the professional programs in software engineering at Carnegie Mellon have undergone significant growth, forming new degree programs through collaborations within the university and with leading academic institutions worldwide.

A partnership with the Korea Advanced Institute of Science and Technology in Daejeon, South Korea, allows students there to fully participate in either the MSE or MSIT-SE program, through a combination of a one-semester residency at Carnegie Mellon, scheduled visits by CMU faculty to KAIST and distance-learning. Another partnership, with the University of Coimbra, led to the 2007 launch of a joint MSE and MSIT-SE dual-degree program in Portugal.

Students also can earn a Master of Science in Information Technology-Software Engineering in Pittsburgh, or in India through a partnership with SSN School of Advanced Software Engineering. A 30-month dual MSE/MBA program is available in conjunction with CMU’s Tepper School of Business, along with a joint certificate program with Cornell University in systems and software engineering.

“All of that leads to a fairly interesting mix of things—it’s a busy and complex organization,” Garlan says. “But we like it that way. It’s a good measure of our success, and it lets us evolve fairly dynamically to changing situations.”

In the future, Shaw hopes to see the MSE program staying nimble enough to respond to the ever-changing needs of the software engineering field. “With the success of the Internet in the past 10 years, the world of software and computing has changed dramatically,” she says. “Our MSE program is well-positioned to respond to new kinds of software demands like this, while hopefully remaining the best in the world.”

Garlan would like the MSE program to widen its sphere of influence even further by fostering more global partnerships—but he also understands the need for the program to maintain its intense focus on training the most motivated and qualified software engineering professionals.

“We have tremendous students,” he says. “They work their tails off, and in the end, they come back and tell us how appreciative they are for the wonderful experience. That’s the ultimate (reward) for any teacher.”

Jennifer Bails is a science and technology writer based in Pittsburgh. She wrote about Edmund Clarke in the Summer 2009 issue of The Link.

Keeping the Human in the Loop

Sometimes it's impossible to automate all security tasks.

There are steps system designers and operators can take to make sure their users don't fumble critical security tasks.

“Humans are incapable of securely storing high-quality cryptographic keys, and they have unacceptable speed and accuracy when performing cryptographic operations. (They are also large, expensive to maintain, difficult to manage and they pollute the environment. It is astonishing that these devices continue to be manufactured and deployed. But they are sufficiently pervasive that we must design our protocols around their limitations.)”

Charles W. Kaufman, Radia Perlman and Mike Speciner, in “Network Security: Private Communication in a Public World”

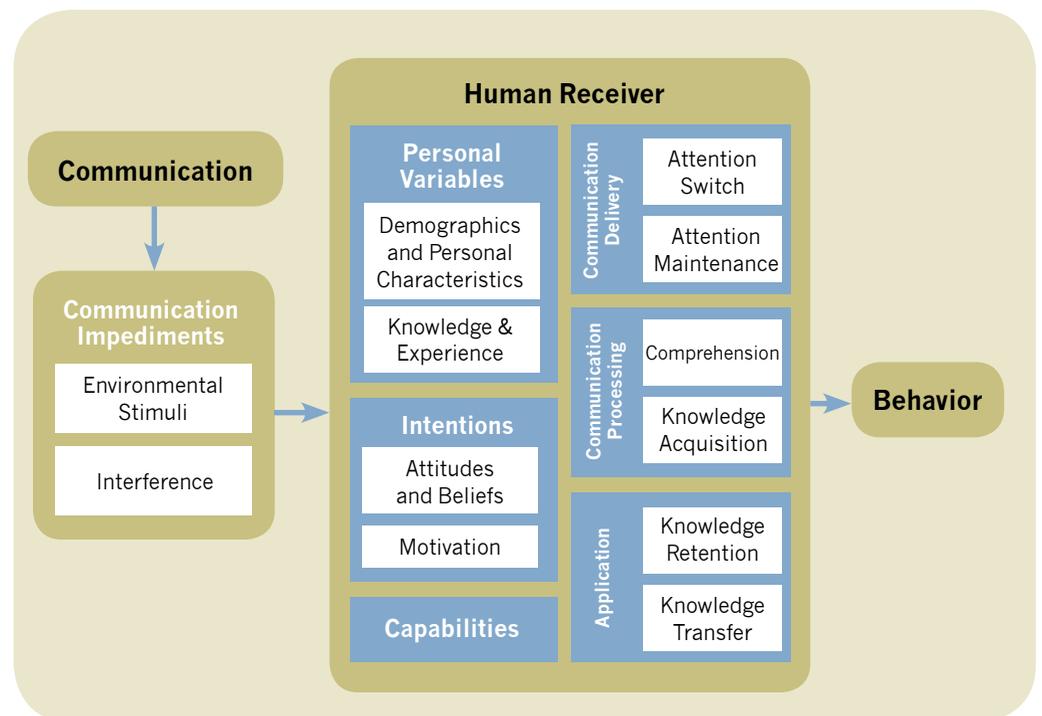
> By Lorrie Faith Cranor

Humans are often thought of as the weakest link in computer security. Increasingly, security breaches are attributed to human error and social engineering attacks, and lack of compliance with organizational security policies is becoming a major security concern.

We warn users not to respond to “phishing” emails that are trying to pry out their credit card or bank account data, but they respond anyway. We build warnings into Web browsers that tell them not to visit sites that contain malicious code, but they breeze past our messages.

With so many security failures attributed to humans, secure systems that don't rely on a “human in the loop” to perform security-critical functions are attractive. Automated components are generally more accurate and predictable than humans, and they don't get tired or bored.

Indeed, in some areas we've seen significant progress towards secure systems that “just work” without human intervention. For example, while early anti-virus programs prompted users to make



a decision about every detected virus, today many anti-virus programs automatically repair or quarantine infected files in their default mode of operation. Thus, anti-virus software no longer relies on inexperienced users to make security-critical judgments.

When software is likely to be able to make better security decisions than a human, removing the human from the loop may be wise. Likewise, well-chosen default settings may result in better security configurations than most humans would choose on their own.

Some Systems Need People

But in some cases, we can't avoid relying on humans to perform critical security functions. Tasks that rely on human knowledge in certain contexts can be difficult for computers to reason about. For example, people are still better than

computers at recognizing faces in crowds, or spotting other people who are acting suspiciously. And people may be better judges than computers about whether email attachments are suspicious in particular contexts.

We also rely on human users to make decisions when it's difficult to program a computer with all of the nuances of a particular policy so that it can handle special cases. In other circumstances, automated systems can be too restrictive, inconvenient, expensive or slow. Some secure systems require people to physically manipulate objects such as smartcards. Other secure systems rely on the use of secrets—such as passwords—where people store and protect the information, and produce it when needed. Finally, most systems that restrict access to only certain people need those people to complete authentication.

Secure systems that rely on keeping humans “in the loop” are vulnerable not only to malicious >>>

Knowledge retention refers to the user's ability to remember the warning when a situation arises in which they need to apply it, and then to recognize and remember the meaning of symbols or instructions.

attackers, but also to non-malicious people who don't understand when or how to perform security-related tasks; who are unmotivated; or who aren't capable of making sound security decisions.

To protect against those threats, we have to systematically analyze the human role in secure systems to identify potential problems and reduce the likelihood that they'll arise.

Building a Framework

When we send out a security message or warning, we want the user to understand what action to take, and then complete that action. But many variables—some outside of our control—can influence the way that a user reacts.

That's why it's useful for the designers and operators of secure systems to have a framework for understanding why their users might fail to complete security tasks correctly, and therefore reduce the number of failures.

One approach we've proposed at Carnegie Mellon is called the "human-in-the-loop" security framework. (With this framework, we're primarily interested in understanding the behavior of non-malicious users—people who aren't attacking the system.) Designed to help us understand the behavior of people whom we expect to perform security-critical functions, it's based on a simple communication-processing model in which a message is sent to a receiver (the human user), triggering a certain behavior. (See the chart on page 17.)

The behavior that occurs depends on the outcome of several steps taken by the receiver to process the feedback from the user. Security actions taken by users are usually triggered by a communication—for example, an on-screen alert, a software manual or a lesson delivered in a training session—so we built our framework on

the Communication-Human Information Processing (C-HIP) model first proposed by Michael Wogalter of North Carolina State University.

The first component is the communication that will trigger an appropriate behavior, if everything goes as planned. Web browsers provide a variety of pop-up warnings to alert users to "phishing" Web sites, expired security certificates and other hazards, along with passive warning indicators in the borders, or "chrome," of the browser windows.

Research shows that some users ignore or don't respond properly to warning messages, so they generally should be used only as a last resort—when it's not feasible to design a system that's fully protected against hazards. But in those cases where we can't use software to thwart security threats, we need effective warnings that get the users' attention; convince them to take action; and provide clear instructions on how to avoid or mitigate a hazard.

Unfortunately, warning messages can encounter obstacles along the way. Distractions (both on-screen and off-screen) can divert a user's attention. For instance, users might be so focused on their primary tasks that they don't take the time to read security messages. The more passive a communication is, the more likely that environmental stimuli—including things such as noise in the room—will prevent users from noticing it.

Passive indicators also compete for attention with one another: If a warning message is confined to the browser "chrome," it might be lost in the clutter created by other extensions installed in the software.

Each user, or "receiver," brings to each situation his or her own personal variables, intentions and capabilities, which influences the way they process the information they receive. The first step in reaching the receiver is delivering the warning message, and that requires both "attention switch" and "attention maintenance."

Grabbing, and Holding, Attention

"Attention switch" means making users aware of the warning messages, and "attention maintenance" means holding their awareness long enough for them to fully understand what the messages mean. In the case of a simple symbol that changes color, shape or size, "attention maintenance" might mean focusing them on the indicator long enough to recognize the message it's conveying. For longer, more detailed warnings and alerts, it means holding the user's attention long enough to read, watch or listen to the message completely.

All sorts of variables affect attention switch and maintenance, including format, font size, length and type of delivery. We also have to guard against habituation—the tendency for the impact of a warning to decrease over time as people become more accustomed to it. In practice this means that users may ignore security indicators that they observe frequently.

Comprehending the Message—and Responding

The next step is communication processing, which includes comprehension—the user's ability to understand the message we're trying to deliver—and knowledge acquisition—the user's ability to respond to the message.

Comprehension is affected by many things, including the type of symbols used as indicators, their similarity to related symbols and the vocabulary and sentences in warning messages. Short, jargon-free sentences, familiar symbols and unambiguous statements about risk all aid comprehension.

Knowledge acquisition depends on the extent of training provided to the user and their involvement during the training. A user may comprehend a security warning and understand that they must take action to avoid a hazard, yet have little or no training on what specific steps are needed. Good warnings include specific instructions on how to avoid a hazard.

Putting the Knowledge to Use

The final information-processing step is application, which consists of knowledge retention and knowledge transfer. Knowledge retention refers to the user's ability to remember the warning when a situation arises in which they need to apply it, and then to recognize and remember the meaning of symbols or instructions. It's impacted by the frequency and familiarity of the message, the user's memory and the quality of the training—more interactive training exercises improve the user's ability to retain the information. Highly interactive training also improves knowledge transfer—the ability of users to recognize situations where they need to remember their training and how to apply it.

For example, users may retain knowledge from anti-phishing training, and use it to analyze email messages similar to those they were shown. If they can apply this knowledge to other types of email messages—or even to suspicious messages sent through other channels—then they've transferred this knowledge.

Outside Variables Also Affect Response

Personal variables such as age, gender, culture, education, occupation and disabilities also affect the user's response to warning messages. When designing a secure system that depends on human intervention, it's important to consider what kinds of people are likely to use the system, and how they're likely to behave based on their personal background and their previous knowledge and experience. Expert users with computer-security-related training may be more likely to understand complicated instructions than novice users. On the other hand, experts may also be more likely to second-guess security warnings and conclude that a situation is less risky than it actually is.

The chart on page 17 includes a box called “intentions.” Those include a variety of factors, such as attitudes, beliefs and motivation, all of which influence whether the user decides a communication is worth paying attention to, and acting upon.

Why Don't They Act?

A number of theories are useful for understanding why users may receive and comprehend security warnings, yet decide not to bother acting on them. Since warning messages often distract users from their primary tasks, they may view their own needs as more important than avoiding security risks, and ignore the communications they receive. Or, if they've gotten erroneous warnings—false positives—in the past, they may be inclined not to take future messages seriously. Or, they may feel obligated to ignore warnings due to a need to examine a potentially unsafe document or complete a necessary task.

To motivate users, organizations may need to create incentives to comply with security policies, and disincentives for not complying.

Finally, even if receivers comprehend a security message, understand how to apply it and recognize a situation where they should apply it, they might not have the capability to take the appropriate actions. They may lack certain software, devices or skills. For example, many password policies require users to remember long, random strings of numbers and letters. Users may fail to comply because they're not capable of performing that memory task.

Strategies for System Designers

There are three high-level strategies for building secure systems that humans can use.

The first strategy is to find ways to get people out of the loop and build systems that “just work” without involving human users in security-critical functions. Designers working on secure systems should consider what functions performed by users might be automated, and what configuration choices might be replaced by default settings that are generally appropriate.

The second strategy is to build systems that are intuitive, and then find ways of making them easy

to use. Secure systems designers should engineer human tasks to maximize the chances that people will perform them successfully.

The third strategy is to teach humans how to perform security-critical tasks. Here we must find effective ways of teaching complicated concepts to people who may not be all that receptive to learning them.

In most cases, we're unable to rely on just one of these strategies and must adopt a multi-pronged approach to secure system usability.

To motivate users, organizations may need to create incentives to comply with security policies, and disincentives for not complying.

Conclusion—and Future Goals

Our proposed framework is intended to help designers and operators of secure systems reduce the occurrence of human security failures.

Future work is needed to validate the usefulness of the human-in-the-loop framework to security engineers; and to develop more specific guidelines and design patterns for mitigating human threats by automating security-critical human tasks and better supporting users as they perform these tasks.

When it's not possible to get people completely out of the loop, it is important that anyone designing, operating or analyzing a secure system understands the human role in performing security-critical functions—and identifies potential failure modes.

Lorrie Faith Cranor is director of the CyLab Usable Privacy and Security Laboratory at Carnegie Mellon University. An associate professor of computer science and of engineering and public policy, she has authored more than 80 research papers on online privacy, phishing and semantic attacks, spam, electronic voting, anonymous publishing, usable access control and other topics.

Cranor, the founder of the Symposium on Usable Privacy and Security, or SOUPS, has served on a number of boards, including the board of directors of the Electronic Frontier Foundation, and has played a key role in building the usable privacy and security research community. Visit her website at lorrie.cranor.org.



Tina M. Carr (HNZ'02)
SCS Director of Alumni Relations
tcarr@cs.cmu.edu

Transition and Impact

As I look ahead to spring and graduation, I can feel the excitement of our graduating students. But I can also foresee the difficulties they will face transitioning from “students” to “alumni.”

Graduation is a time filled with excitement and often uncertainty. Graduates are faced with many challenges including navigating a new city, starting a career or continued course of study and establishing new networks.

The SCS alumni community is a great resource for new graduates to turn to for help. Our alumni can ease a graduate’s transition by offering advice on places to live, providing business contacts or simply sharing their post-grad experiences over lunch.

Working as the director of alumni relations (and as an alum), I’ve found the transition from student to alumnus doesn’t mean we lose our shared experiences and memories from Carnegie Mellon. Instead, the work and social connections made as a student become part of the foundation of your life.

As an alumnus you continue to grow professionally and personally. And just as new graduates gain from our alumni community, so do you, our seasoned alums. By participating in our alumni activities, you continue to build upon those foundations and maintain the valuable connections you created during your years spent on campus.

For those who participate in alumni activities the rewards are many:

- You will grow and contribute to a new community. Serving as an alumnus volunteer provides a forum to share your experiences with others, whether it’s a fellow alumnus, current or prospective student or faculty member.

For example, this past spring SCS alumni Andrew Widdowson (CS’05) and Kayvon Fatahalian (CS’03) hosted a reception for prospective SCS students and their families in the San Francisco Bay area. The event provided an opportunity for alumni to talk about their time on campus, answer questions about the program and share their thoughts on careers in computer science.

The event made a positive impact. Several prospective students made the decision to attend Carnegie Mellon after participating in the Q&A reception. Before attending the event, Kevin Lang, a current SCS freshman, was unsure whether he was going to enroll at Carnegie Mellon. Lang said later: “This event strongly swayed my decision ... The alumni were able to give us insights that aren’t available at other places.”

- You create a wider network, foster mutually beneficial professional relationships and create new friendships. In times of economic stress, these nets might see you through tough times.

Carnegie Mellon Network Nights, for example, bring together hundreds of alumni and students with potential employers at receptions across the country every year. It’s a valuable opportunity to meet and discuss job possibilities, share career experiences and advice and make new business contacts.

- You impact faculty and the university by staying involved in activities through volunteering on alumni boards, hosting or attending events, talking to students, serving as a recruiter or making a gift.

Our alumni are our greatest ambassadors and advocates. Without your support, we could not continue attracting the best and brightest minds, fulfill the university’s education and research missions or continue to elevate the school and university’s position as a world-class institution.

We thank all of our alumni around the world for their time, energy and support!

If you would like to learn more about volunteer opportunities or have comments or suggestions, feel free to email me at tcarr@cs.cmu.edu.

Cheers,

Tina M. Carr (HNZ’02)
Director of Alumni Relations
School of Computer Science



Mark Stehlik, assistant dean for undergraduate education (fifth from left), joined about 40 SCS and ECE alumni and students for a luncheon Aug. 1 at the Pacific Science Center in Seattle.

>> Look for more photos online at link.cs.cmu.edu!

Members of the SCS Alumni Advisory Board who attended the dedication of the Gates and Hillman centers included Jonathan Betz (CS'99), Ajay Jain (CS'91,'92), Chris Maeda (CS'92,'97), Sriram Gollapalli (CS'02, MISM'03), Amy Matzke (CS'07), Boris Sofman (E'05, CS'05,'07), and Anita Taylor (CS'07).



More than 260 alumni and students from the School of Computer Science and the Department of Electrical and Computer Engineering attended our afternoon barbecue July 25 at Sam's Chowder House on the shores of Half Moon Bay, just south of San Francisco.



Giving Back

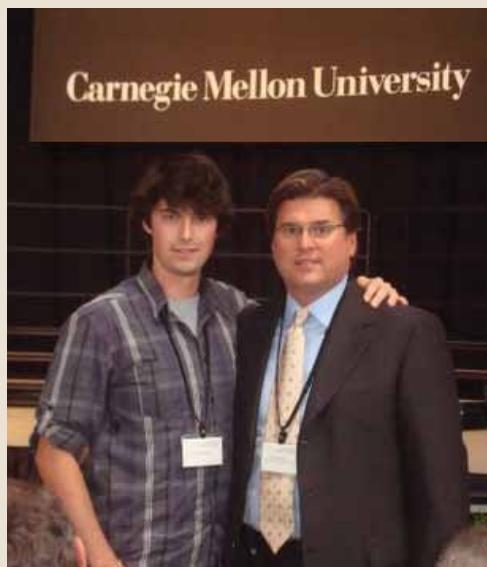
Rick and Amy Weidinger got caught up in their son's enthusiasm for CMU

> By Mark Dorgan

Rick and Amy Weidinger visited Carnegie Mellon in the fall of 2008 to see their son, Paul, a freshman majoring in computer science. They arrived on campus expecting to find the School of Computer Science an impersonal place of robots and computers, Rick Weidinger says, and were unprepared for what he calls "a culture of advancement."

The spirit of collaboration was "clearly evident," Rick Weidinger says. The Weidingers came away far more impressed than they had anticipated—and by the end of their visit, they'd caught their son's enthusiasm for his new school. They went home determined to find other ways to become more engaged with the university.

Weidinger is chief executive officer and chairman of McLean, Va., based Braintech Inc., which designs, develops and deploys vision-guided robotic systems, or VGRs—automated tools, such as those used on assembly lines, that can navigate through their environments using industrial cameras. Naturally, he was interested in the work of Reid Simmons, research professor in the Robotics Institute, and his success with social robots that interact with humans, such as Carnegie Mellon's "roboceptionists."



Paul Weidinger and dad, Rick

Simmons had recently started working on a new interactive robotics project called Gamebot, which is designed to serve as a "destination" platform for visitors to experience first-hand advances being made in human-robot interaction. The Weidingers' interest was piqued. After learning more about the project, they decided to make a personal gift as a part of the university's "Inspire Innovation" campaign in support of Simmons' work on Gamebot.

"Gamebot is broad reaching—it combines elements of robotics, computer science, design, drama, engineering, vision, interaction among participants and fun," Rick Weidinger says. "Gamebot will be a destination that will create a unique and valuable learning experience for the entire campus community."

When completed in spring 2010, Gamebot will reside on the third floor of the Gates Center for Computer Science. Simmons says the Weidingers' generosity will help him advance Gamebot's development—particularly in the area of personalizing its reactions to visitors through vision-guided robotics—and will help him continue to collaborate on its "personality" with help from the School of Drama in the College of Fine Arts.

Rick Weidinger says he's seen first-hand the need for continual innovation in machine-vision technologies, and that research like Simmons' helps advance the state of the art. "We feel this show of support may lead to future projects, future developments and in fact inspire one more soul," he says.

And as parents of a current student, Rick and Amy Weidinger also feel that their gift represents an important vote of confidence in both the School of Computer Science and their son. "It's important to support your children's decisions and this is another way of demonstrating our support and confidence," Rick Weidinger says. "We as parents can help Carnegie Mellon fulfill its mission of education through collaboration."

The "Inspire Innovation" campaign recently topped the \$600 million mark. To find how you can help the School of Computer Science, whether through scholarships and fellowships, faculty support or gifts toward the Gates and Hillman centers, 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 principal giving advisor and development liaison for the School of Computer Science.

Frederick “Fritz” Knabe

B.S., Computer Science, Princeton University, 1998
M.S., Computer Science, Carnegie Mellon University, 1991
Ph.D., Computer Science, Carnegie Mellon University, 1995



SUBMITTED PHOTO

Data-storage developers and data-mining researchers are in an arms race, Fritz Knabe (CS'91,'95) says. Each time it seems that disc technology has reached its limits, someone comes up with something new. And as non-volatile, flash-based memory also drops in price, there soon won't be any reason to ever delete data, says Knabe, newly appointed distinguished engineer at Marlborough, Mass., based Netezza Corp.

But users have to be able to turn data into knowledge, he says, and the old data-processing models are having a hard time staying relevant.

Search engines, for example, are built on a data-retrieval model that requires an informed human user, Knabe says. “We’ve all developed these little strategies for focusing our searches,” he says. But

the only feedback most search engines provide is page rank, and with terabyte- and petabyte-sized databases, relying on the intuition of human users to drill through layer after layer of information is an exercise in frustration. “You would give up,” Knabe says.

Instead, data-processing architects are focused on providing guided navigation—analysis and direction—not just results. “Imagine you’re trying to understand why your company is getting an uptick in warranty claims,” Knabe says. “You may have a human being following their intuition and searching for certain patterns, but they’re working with a machine that can actually allow them to apply that against analysis being done by the machine with a really rapid turnaround.

“When human beings are able to use computational engines as tools to understand the world around them, it’s tremendously exciting,” he says.

Besides data analysis, Knabe is also enthusiastic about cooking. He developed a love for working in the kitchen—especially baking his own bread—during his Carnegie Mellon days, when he was a member of the SCS Dinner Co-Op. Knabe and his wife, Louise, also enjoy bicycling. Many of their trips explore the New England area, but they’ve also biked through Switzerland on a tandem bike that folds up for easy storage and transportation. “We call it our clown bike,” he says, laughing.

—Jason Togyer (HS'96)



SUBMITTED PHOTO

Yu Shan Chuang

B.A., Biology and Computer Science, Northwestern University, 1999
M.H.C.I., Human-Computer Interaction, Carnegie Mellon University, 2000

Interfaces depend on two things, she says—discoverability and learnability. The first describes how difficult it is for users to figure out what they’re supposed to do, while the second measures how quickly they learn it.

Consistency, Chuang says, helps learnability, “even if your product is not extremely user-friendly—even if users learn in odd patterns—at least they can learn how to use it.” Nine years working for some of the Web’s biggest content providers has inured Chuang to bad interface design, though there are still things that drive her nuts.

Among her pet peeves are companies that conceal important content under flashy animations and graphics. It goes against the principles that were engrained in Chuang at the Human-Computer Interaction Institute in 1999 and 2000. “My

focus was always on, ‘How do I make this interface respond faster from step one to step 10?’ and not so much about the flash in-between,” says Chuang, who makes Silicon Valley her base of operations. Companies may appreciate pretty designs, she says, but users prefer interfaces that solve their problems quickly.

One of her professors at Northwestern steered Chuang to HCII after it became clear that she was less interested in pure research than in working in the field with people to solve their computing problems. She credits her time at Carnegie Mellon with giving her both the support network and the positive examples she needed to launch her own consultancy last year. “Without my CMU network, I probably wouldn’t have done it,” says Chuang, who relies on her classmates as a resource for her projects. “I feel like it’s definitely made me more entrepreneurial.”

—JT

Reunion marks quarter-century of Andrew



It was the project that turned Carnegie Mellon into the most-wired campus in the world, and on Nov. 6 and 7, the university celebrated the 25th (plus one) anniversary of the Andrew Project with a reunion in Pittsburgh.

“Andrew sort of took everyone by surprise,” says Jim Morris, former dean of the School of Computer Science and Carnegie Mellon’s Silicon Valley campus. In the early ’80s, most computer systems still relied on data terminals linked to central

facilities. The Andrew Project envisioned an open system that relied on the new personal computers to do most of the processing.

Although other people had tried creating networks of PCs, Morris says, no one had done it on such a large scale. “In some sense, the entire world copied the distributed computer model,” he says.

The idea for Andrew sprang from a task force established by former CMU President Richard Cyert, which suggested the university develop a computing environment that could be rolled out campus-wide. In 1982, Carnegie Mellon and IBM formed the Information Technology Center and set a five-year deadline for creating a distributed computing network providing email, word processing, file sharing and other amenities.

A year later the Andrew Project—named for Andrew Carnegie and Andrew Mellon—was born. By 1986, the Andrew User Interface System had debuted, and within the decade, practically all of the campus’ buildings had been wired. Many technologies pioneered as part of the Andrew Project inspired commercial software, including the Andrew File System, a secure, scalable, distributed file system that continues to be actively developed.

Andrew veterans who attended the reunion were welcomed by the reappearance of pink flamingos—a longtime symbol of the Andrew Project—on the top of Cyert Hall (formerly the University Computing Center). The keynote address was

delivered by James Gosling (CS’83), a vice president and fellow at Sun Microsystems who’s known as the father of the Java programming language.

Gosling was the lead implementer of Andrew’s user interface and one of about a dozen speakers who reflected on their experiences. His lecture in the Rashid Auditorium reflected on the history of Java, some of its unusual uses and future directions for its development—including on mobile devices.

New lab offers better access to open-source software



A new laboratory in the Gates Center for Computer Science will support research and experimentation with free and open-source software.

Jim Whitehurst (below), president and chief executive officer of Red Hat Inc., joined Carnegie Mellon faculty and staff Nov. 12 for the ribbon cutting at the new Red Hat Computer Laboratory.

The laboratory is actually in two locations—on the third floor next to the R-Bar Café, and on the fifth floor. Together, those locations contain 60 workstations equipped with Fedora and Red Hat Enterprise Linux and will be open 24 hours, seven days a week.



The Red Hat lab replaces a small “Linux Lab” which held only 15 machines. Demands on that lab often outstripped its capacity, says Greg Kesden, SCS director of undergraduate laboratories, and at times four students were lined up to share each workstation.

“We couldn’t be happier about our partnership with Red Hat and we are thankful for their generous contribution that will make the computer lab a reality,” Kesden said.

Michael Cunningham, executive vice president at Red Hat, called SCS “one of the foremost computer science institutions in the world” and said the company was proud to partner with the university.

Platzer named to PopSci “Brilliant 10” list

Calling him the “Crash Test Anti-Dummy,” Popular Science magazine has named Carnegie Mellon’s Andre Platzer to its annual “Brilliant 10” list of the most outstanding young scientists in the United States.

An assistant professor of computer science since 2008, Platzer was cited for his work on verification software that helps prevent accidents in so-called “cyber-physical” systems—computer applications that interact with physical objects, such as air-traffic control networks and robotic surgery tools. Platzer developed his method for detecting dangerous errors by applying theories of model-checking pioneered by Edmund Clarke, the university’s FORE Systems Professor of Computer Science.



Popular Science compared Platzer’s work to seatbelts, antibiotics and fire hoses, saying his research is so vital that “it’s hard to imagine how we got along without it.”

Platzer is among the researchers participating in Carnegie Mellon’s new Institute for Computational Modeling and Analysis of Complex Systems. Headed by Clarke, the institute was established this year with part of a \$10 million grant from the National Science Foundation. The “Brilliant 10” list appears in the November issue of the magazine.

Project explores low-cost electric commuter cars



A research team at the Robotics Institute has converted a 2001 Scion into a low-cost electric commuter vehicle.

It's part of a project called ChargeCar, designed to explore "community-based" approaches to electric vehicle design, conversion and operation, says Illah Nourbakhsh, associate professor of robotics, co-principal investigator on the effort.

Most electric cars are designed to match the performance of gasoline-powered vehicles, he says. ChargeCar will instead analyze the habits of actual people and then try to develop electric vehicles suited to the needs of the typical urban commuter.

Researchers are also working with Pittsburgh-area auto mechanics to develop local expertise

in converting existing autos to electric vehicles, along with a set of recommended conversion "recipes," Nourbakhsh says.

Key to the ChargeCar project is a control system called "smart power management," which uses artificial intelligence to manage the flow of power between the electric car's batteries and a "supercapacitor." Like conventional capacitors, supercapacitors

store electrical charges, but they have an unusually high density, and can serve as a buffer between a vehicle's batteries and its electric motors, improving the car's performance and extending battery life, Nourbakhsh says.

The Scion xB will serve as a test bed for developing smart power management techniques, measuring battery lifetimes and refining conversion techniques.

ChargeCar is also gathering commuter data from the public at chargecar.org. Researchers will use that data to help them custom-tailor electric car solutions.

The ChargeCar team includes Gregg Podnar, co-principal investigator with Nourbakhsh; research engineer Josh Schapiro; senior research program-

mer Chris Bartley; project scientist Ben Brown; Intel Labs Pittsburgh senior researcher Jason Campbell; and students Vibhav Sreekanti, Paul Dille and Matt Duescher.

Robotics grad student wins first QinetiQ fellowship

Daniel Munoz, a first-year Ph.D. student in robotics, is the first recipient of the QinetiQ North America Robotics Fellowship, which will provide him with three years of educational support as well as an internship at the Waltham, Mass., based company.

Munoz, a native of Fargo, N.D., earned a bachelor's degree from Carnegie Mellon in electrical and computer engineering, with a minor in computer science, in 2007.

A subsidiary of UK-based QinetiQ group, QinetiQ North America's businesses include the former Automatika Inc. and Applied Perception Inc., both spinoffs from the Robotics Institute.

QinetiQ specifically created the fellowship to support CMU students and programs, said William Ribich, president of the company's Technology Solutions Group.

Compiled from staff reports

Nokia boosts effort to teach literacy in India

A research grant and a supply of 450 cell phones from Nokia will help expand an effort to teach reading and writing skills to students in rural sections of India.

It's an extension of CMU's Mobile and Immersive Learning for Literacy in Emerging Economies project, known as MILLEE. The project is designing educational games that can be played on mobile phones, says Matt Kam (right), an assistant professor in the Human-Computer Interaction Institute.

Cell phones are ubiquitous in the developing world, he says, even in poverty-stricken villages without personal computers or Internet access. For the past six years, Kam and his colleagues have designed games that teach English language

skills and which will run on cell phones.

The Nokia donations will allow MILLEE to conduct a controlled study involving 800 children in 40 villages, Kam says. "Our previous, smaller studies have shown that students have significant gains in learning when they use these games," he says.

With a larger, more comprehensive study, Kam says researchers hope to understand how to



design and develop phone-based games that could be used by "billions of people" in the developing world.

Collaborators include Maxine Eskenazi, associate teaching professor in CMU's Language Technologies Institute; Leonora Anyango-Kivuva of California University of Pennsylvania; and a group of some 20 graduate students. Undergraduates at the Dhirubhai Ambani Institute of Information and Communication Technology in India are contributing to game development.

In addition to the expansion in India, MILLEE is also planning efforts to teach Mandarin in China and English in Kenya. For more information, visit www.millee.org.

SCREENSHOT



For several days, all eyes were focused on Pittsburgh as world leaders gathered in the city for one singular event.

No, not the “Group of 20” summit. We’re talking about Pogopalooza—the sixth-annual world championship for pogo stick enthusiasts, held in Pittsburgh from Aug. 19–22. The local organizer was Nick Ryan,

a junior in Carnegie Mellon’s Philosophy Department and an avid pogoer.

Pogopalooza showcases so-called “stunt pogo” or “extreme pogo,” which challenges athletes to do more than hop in one place. Instead, pogo athletes compete to perform the highest jumps, best tricks and even the fewest jumps per minute. More than 300 people attended the main event in Schenley Plaza to see 50 contestants face off.

Four athletes at Pogopalooza also tested new versions of BowGo, an extreme pogo stick developed at the Robotics Institute. Invented by H. Ben Brown, a project scientist in the RI, BowGo employs a fiberglass bow that provides five times more “bounce to the ounce” than any similar steel spring.

BowGo was an offshoot of technology developed at the RI to enable legged robots to run and hop efficiently. Although BowGo is not yet commercially available, CMU has licensed the technology to Tanner Research Inc. and a contract has been signed with Razor to market a kid’s version of the BowGo.

It’s got the smoothest ride of any “extreme” pogo stick on the market, according to Ryan, and allows pogo athletes to clear jumps higher than nine feet.

At left, Jake Fagliarone, a 15-year-old pogo athlete from Florida, demonstrates BowGo on the Mount Washington overlook. Top right, a visitor to the Carnegie Science Center tries out a mini version of BowGo. At center, Ben Brown talks about the science of BowGo with an audience at Carnegie Science Center.

There are more great photos from Pogopalooza 6 at our Web site, link.cs.cmu.edu. Why not hop in and take a look?

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Then and Now

When it was launched in 1989, the master of software engineering program at Carnegie Mellon was the first of its kind. Since then, it's become a benchmark for other academic degrees for software engineering professionals.

And the program has continued to grow. Students can now earn a master's of science in information technology-software engineering or a 30-month dual MSE/MBA in conjunction with CMU's Tepper School of Business.

Recent partnerships with universities in South Korea, Portugal and India enable the MSE program to create "agents of change" in those countries as well.

MSE grads will gather in Pittsburgh on March 12 and 13 to celebrate the 20th anniversary of the program. Their reunion will coincide with the final two days of the 23rd annual International Conference on Software Engineering Education and Training, set for March 9–12 and also to be held in Pittsburgh.

You can read more about the MSE program—past, present and future—in Jennifer Bails' story, beginning on page 14.



SUBMITTED PHOTO

Unfortunately, this photo of MSE grads isn't dated and it doesn't have any names on it, but we think it's a portrait of the Class of 1996. Are we right? Do you see yourself or some of your classmates? Please let us know.

Drop us a line at TheLink@cs.cmu.edu or The Link Magazine, School of Computer Science, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA 15213. Three letters we receive will be chosen at random, and their authors will win a nifty Steelers Super Bowl poster. See the inside front cover of this issue for details.