### André Platzer

- · Ph.D., computer science, University of Oldenburg
- M.Sc., computer science, University of Karlsruhe

Most people have made their peace with occasional computer crashes. But when it comes to complex embedded systems like air-traffic control networks or railroad signals—software or hardware failures can be deadly.

Reliable verification processes "can avert potential catastrophes," says André Platzer, an assistant professor of computer science at Carnegie Mellon since 2008.

Platzer is a former student and current collaborator of model-checking pioneer Edmund Clarke, Carnegie Mellon's FORE Systems Professor of Computer Science and a 2008 Turing Award winner. As a doctoral student at the University of Oldenburg, Platzer developed the first theorem for verifying complex hybrid systems—"cyber-physical" networks where computers control moving objects such as airplanes, automobiles and trains and subways.

The same model-checking techniques have applications in other cyber-physical systems, including medical technologies, Platzer says. Automatic digital decision-making is a key function of machines such as artificial respirators and blood glucose monitors used by diabetes patients.

"Ensuring correct functioning of complex physical systems is among the most challenging and most important problems in computer science," he says. "Because of the fatal consequences of malfunctions, there are tremendous safety requirements for these systems."

When analyzing the behavior of these critical systems, "classical uninterpreted first-order

logics are not sufficient," he says. "We need dedicated logics that are suitable for the mixed discrete-continuous realm of hybrid systems, in which properties of their transitions can be stated and proven."

Recent honors for Platzer have included being named to Popular Science's 2009 Brilliant 10 list, a best paper award at the 2007 International Conference on Automated Reasoning with Analytic Tableaux and Related Methods, and a 2006 Woody Bledsoe Award from the International Joint Conference on Automated Reasoning.

### Matthew Kam



- Ph.D., computer science, University of California at Berkeley
- B.S., electrical engineering and computer science, University of California at Berkeley
- B.A., economics, University of California at Berkeley

Many teachers regard cell phones in the classroom as a distracting nuisance. But Matthew Kam

thinks they actually have potential to deliver classroom lessons in the developing world.

Kam, an assistant professor of human-computer interaction at Carnegie Mellon since January, says many nations in the developing world have extensive and inexpensive mobile phone networks, even in rural areas where computers are rarely found.

Of 4 billion cell phones currently in use, he says, more than half are in developing countries. But at the same time, many of those phone users are functionally illiterate—in India, for instance, where about a third of the adult population cannot read or write proficiently, nearly half of the people have cell phones.

As a doctoral student at Berkeley, Kam developed a project called Mobile and Immersive Learning for Literacy in Emerging Economies. MILLEE delivers lessons in English one of India's two national languages—to cell phones in the form of educational games.

Over the next two years, about 800 students in 40 Indian villages will participate in the project's first large, controlled trials, where games will prompt students to match words with meanings and phonetic sounds with letters of the alphabet.

"We've tried to adapt traditional village

games to video environments, rather than 'drill and kill' exercises," says Kam, who minored in education at Berkeley. Other influences were cultural. Since even rural villagers knew the story of Kalpana Chawla, the first Indian-born female astronaut, Kam's team created a space-themed game that allowed students to blast asteroids by selecting the correct words.

MILLEE is currently working with the Pittsburgh Science of Learning Center—a joint project of Carnegie Mellon and the University of Pittsburgh—to expand its work to underserved regions in China to see if mobile phone games can improve literacy in Mandarin. The program is also being expanded to Kenya, where games developed by MILLEE will be used to teach English.

#### **New Faculty Profiles**

## Adrien Treuille

- Ph.D., computer science, University of Washington
- M.S., computer science, University of Washington
- B.S., computer science, Georgetown University

Curling smoke, splashing water, a spinning galaxy—Adrien Treuille wants to put them all into the palm of your hand. In simulated form, of course.

Until now, realistic simulations of complex three-dimensional forms have been out of reach of most people "because they don't have access to supercomputers," says Treuille, an assistant professor of computer science and robotics who joined the Carnegie Mellon faculty in 2008.

But a combination of breakthroughs in computer speed and new algorithms is making these simulations accessible "to virtually anyone," he says. Treuille's research focuses on ways to make realistic computer simulations run in real-time on everyday computers. Such advances could help engineers design better controls for cars and airplanes and could create more realistic simulations for training firefighters and other emergency responders, he says.

In education, students could use the techniques to learn physics by creating worlds in which the laws of physics are modified. "For instance, if you replace the famous 'force equals mass times acceleration' equation with 'force equals mass times velocity,' you find yourself in a strange molasses-like world where a rolling ball comes to rest as soon as it's no longer pushed," Treuille says.



In August, Treuille was selected from among 300 nominees for inclusion on the prestigious TR35, Technology Review magazine's list of the world's top 35 innovators under the age of 35.

Work already done by Treuille has provided the basis for Draft Track, the special effect used on telecasts of auto races that allows viewers to "see the air" behind the speeding vehicles. He also contributed to the online game Foldit, which harnesses the brainpower of thousands of gamers to help biochemists unlock the mysteries of how proteins fold.

## Venkatesan Guruswami



- M.S., computer science, Massachusetts Institute of Technology
- B.Tech., computer science and engineering, Indian Institute of Technology, Madras

The general public is liable to appreciate research into improved MP3 music players and digital televisions a lot more than theoretical work on NP-hard problems.

Yet both have captured the interest of Venkatesan Guruswami, a leading researcher in theoretical computer science, who joined the Carnegie Mellon faculty as an associate professor of computer science on July 1.

And both have benefited from Guruswami's elegant approach to solving complex problems, says Peter Lee, former head of the Computer Science Department. "Venkat's work is beautiful and has significant practical implications in a range of areas, from wireless communications to language processing," he says.

A visiting professor at Carnegie Mellon since 2008, Guruswami is well known for his groundbreaking contributions to error-correcting codes, which are critical to the operation of computer hard drives, MP3 music players and digital televisions. His work, begun with Madhu Sudan of the Massachusetts Institute of Technology, showed it was possible to detect and correct much larger errors in digital signals than previously considered possible.

That discovery led to new ways to detect weak signals in noisy environments. More recently, Guruswami and his Ph.D. student Atri Rudra—now a faculty member at the University at Buffalo—answered a 50-yearold problem in coding theory by constructing error-correcting codes with the best possible trade-off between the rate of data transfer and the number of errors corrected.

Guruswami also does extensive work in computational complexity theory, exploring the dividing line between computationally tractable and intractable problems and the degree to which approximation can provide acceptable answers for a class of computationally difficult problems known as NP-hard problems.

Guruswami's honors include a David and Lucile Packard Fellowship for Science and Engineering, an Alfred P. Sloan Foundation Fellowship and a National Science Foundation Early Career Development Award. During the 2007-08 academic year, he was on leave at the prestigious Institute for Advanced Study in Princeton, N.J.

## Aniket Kittur

- Ph.D., cognitive psychology, University of California at Los Angeles
- B.A., psychology, computer science and cognitive science, Princeton University



As soon as the news broke that pop singer Michael Jackson died, someone went on Jackson's Wikipedia page and updated it, including the latest information. When Barack Obama won the Nobel Peace Prize, this tidbit was added immediately on his Wikipedia entry.

There's been much controversy regarding the accuracy of Wikipedia's encyclopedic information, but Niki Kittur is interested in Wikipedia for another reason. As an assistant professor in the Human-Computer Interaction Institute at Carnegie Mellon's School of Computer Science, he's using Wikipedia to learn more about how people work together rather than learning more about famous people.

More importantly, Kittur uses Wikipedia edit logs to understand how people work in groups. Organizational psychologists garner most of their information about workplaces from survey data, but Wikipedia allows Kittur to watch how people organize themselves to complete a task. And he has discovered that people work together differently than organizational psychologists once thought. It was once believed that treating people the same in the workplace ensures that employees are happy. But it seems that when people are welcomed individually to a Wikipedia community and given constructive criticism, they are more likely to contribute and do a better job.

Studying online communities seems like a natural path for Kittur. After graduating with an undergraduate degree in computer science and cognition from Princeton, Kittur began working as an Internet consultant, serving as a programmer and architect. Like most consultants, Kittur had a great deal of experience working in groups. Even though he left his full time work as a consultant, Kittur still does freelance Web site design and is an avid photographer. He also contributes to the Cognitive Atlas Project, a collaboration that is developing ontology of mental processes, tasks and brain systems.

# Aarti Singh

- B.E., electronics and communication engineering, University of Delhi
- M.S., electrical and computer engineering, University of Wisconsin at Madison
- · Ph.D., electrical and computer engineering, University of Wisconsin at Madison
- Postdoctoral Research Associate, applied and computational mathematics, Princeton

Aarti Singh describes her work as being at the "intersection of statistical learning and signal processing." Her research focuses on ways to extract information from complex networks whether comprised of the neurons in the human brain, the nodes of the Internet or the many transmitters of a wireless communications system. In all of those cases, Singh says, researchers must detect weak and sporadic signals from many thousands of locations, and develop useful models for understanding what those signals mean.

Singh joined the Machine Learning Department as an assistant professor in August. Much of her present work in network forensics is focused on detecting anomalous behavior such as spotting incipient congestion on the Internet by measuring end-to-end traffic rather than tracing it through core routers. "If there are groups of nodes that share common links, they'll tend to show changes at the same time," Singh says. "The question is, how soon can we detect when there is a change—and if so, where in the topology a change occurred?"

Although her models currently employ off-line data, they could eventually lead to methods for analyzing real-time network traffic, enabling network administrators to devise better practices for dealing with Internet congestion.

In addition, many areas of Singh's research employ theories of semi-supervised and ac-



tive learning—creating processes that deduce end

functions by seeking patterns in unlabeled data. Singh envisions a day when new Internet protocols can route traffic themselves, without human intervention, by learning and relearning the quickest routes through data analysis.

While completing her graduate study at the University of Wisconsin at Madison, Singh applied similar data-analysis techniques to functional magnetic resonance imaging, or fMRI, scans of brain activity; and to the performance of 802.11 networks. "I'm trying to bridge the gap between methods that are theoretically optimal, and those that are practically useful," she says.



#### About the School of Computer Science

Faculty and graduates of the School of Computer Science at Carnegie Mellon University have been advancing the field of computer science since 1956.

At its campus in Pittsburgh, the school offers a range of undergraduate and master's degrees, as well as several doctoral programs. In addition, since 2004 Carnegie Mellon has offered computer science undergraduate degrees at the university's campus in Doha, Qatar.

SCS's diverse interdisciplinary research and education extends into areas beyond the traditional boundaries of computer science. An example is the Entertainment Technology Center, a joint initiative of the School of Computer Science and the College of Fine Arts that brings together technologists and artists in close collaboration. Learn more at www.cs.cmu.edu.

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