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Assistant Professor Changxi Zheng

Forbes Names New Faculty **Changxi Zheng One of "30 Under 30"**

"**Changxi Zheng's** algorithms use physical laws to produce realistic natural sounds, such as splashing liquids and shattering glass. What the past decades of graphical rendering research did for our eyes, Zheng's pioneering work is doing for our ears."

– EITAN GRINSPUN

CHANGXI ZHENG received his PhD in 2012 from Cornell University and his B.S. from Shanghai Jiaotong University both in Computer Science. His research spans physically-based animation, computational acoustics, scientific computing and robotics, with a focus on developing practical computational methods to produce realistic dynamics and multi-modal sensations. He has developed a variety of physically based sound synthesis methods for computer animation. His work has been featured in various press coverage (NPR, BBC, Science Daily, New Scientist, etc.). He is recently listed as one of Forbes' "30 under 30" innovators in science and healthcare.

What attracted you most to a faculty position at Columbia?

It's the people here at Columbia. Here we have a very vibrant and friendly department. I received a very warm welcome on the first day I joined the department. Since then, my colleagues have helped me tremendously. They are the real experts in their fields. Being together with those amazing people also motivates myself to be as good as them. Moreover, we have very talented students here, and I enjoyed very much working with them.

What are some of your ongoing research projects?

Recently I have been working on projects centering around a few topics. One is to create realistic sound synchronized with associated visible motions.

(continued on next page)

Another is to bridge a few mathematical tools, such as multi-scale analysis and applied dynamical system analysis, to help accelerate or design detailed computer graphics simulations.

How do you pick your research topics and what do you believe makes a good research question?

I gauge a research topic by its originality, novelty and practical significance. I believe a good research question should clearly distinguish itself from previous work in the sense that it enables us to do what previous methods couldn't do or do it in a faster, easier and more elegant way.

Where do you see your field progressing over the next decade?

My guess is that the fundamental tools that enable us to create a realistic virtual world will become much more full-fledged. We will have techniques to create different motions, sounds and other modalities in an easier, more principled and more accurate way. With those tools in hand, we will be able to develop techniques that enable normal people to do all kinds of creative work which only the professionals can do currently.

What are some of your future research goals?

I would like to be a tiny little "god" in my own right, recreating the world in computer. My current work aims to develop efficient methods for both visible and audible realistic dynamics. The ultimate goal is to create a realistic virtual world that people can see, hear and sense.

Do you see any key applications or commercial opportunities for your work?

The film industry, interactive environments, virtual training and industry design all have numerous applications of the technologies that I'm working on. The key aspects that my work can provide is the realism and efficiency of creating virtual dynamics, including both the visible and audible effects. Creating an immersive virtual world enables people to sense the world in computer, try out different things easily, and ultimately augment our humanities for more productive and creative work.

If you were advising students at the undergraduate level who wanted to do what you're doing now, how would you suggest they go about it?

Dancing between mathematics and programming is basically the way to go about it. Beside solid programming skills, I would suggest the passionate undergrads learn some related math and physics background, such as the numerical linear algebra, numerical integration methods, or some preliminary mechanics. They can then get a general picture of the field by briefly reading through some research papers. If interested, they can also start to implement some cool stuff with a specific idea or technique—graphics is full of cool things (a video game, a neat visualization app, a small animation etc.).

CS Ph.D. Candidate **Vasilis Pappas Takes Microsoft's Blue Hat Honors**

Amid a shower of confetti at Microsoft's Researcher Appreciation Party at the corporation's annual Black Hat security conference in Las Vegas, computer science Ph.D. candidate **Vasilis Pappas** claimed the Blue Hat Prize for his kBouncer software security technology.

Microsoft created the prize to encourage security researchers to develop the best defensive technology to limit the impact of hackers attacking the company's Windows operating system.

Pappas explains that kBouncer "checks upon each request to the operating system's kernel (such as for files, network operations, etc.) to verify that the requesting application has not been compromised or attacked."

Pappas developed kBouncer to detect and prevent return-oriented programming (ROP), a popular method of exploiting vulnerable computers. He compares ROP to a ransom note, in which kidnappers cut printed letters from magazines to piece together a message to conceal their identities.

"Attackers just reuse small fragments of the vulnerable application's existing code, instead of injecting new code, in order to achieve their goal," he says. "kBouncer is able to detect whether code is executing normally, or smaller fragments are chained together, such as when ROP is executing."

The award, announced July 26, includes a $200,000 prize for Pappas, who is working with a group under Professor Angelos D. Keromytis on software security projects funded federally by IARPA (the Intelligence Advanced Research Projects Activity) and DARPA (Defense Advanced Research Projects Agency).

"Vasilis has been doing high-quality work in this and other research areas for three years," Keromytis says. "I am very happy and not really surprised that he won. He is creative, methodical, and hard working—all the necessary ingredients for success."

With a smile, Pappas says he has no plans yet for the prize winnings. "It's the next problem I'll focus on."

The industry panel featured speakers from leading technology giants. From left to right: Panel moderator Kyle Kimball, executive director of New York City Economic Development Corporation; Ben Fried, chief information officer at Google; Jennifer Tour Chayes, distinguished scientist and managing director of Microsoft Research New England and Microsoft Research NYC; Shawn Edwards, chief technology officer at Bloomberg; and Justin Moore, engineer at Facebook.

Institute Director Kathleen McKeown chats with Shawn Edwards, an Engineering alumnus and CTO at Bloomberg, one of the Institute's latest industry partners.

Raimondo Betti (right), chair of the Department of Civil Engineering and Engineering Mechanics, represents the Institute's Smart Cities Center and talks about some of the exciting research already underway. Also pictured, Orin Herskowitz (left), executive director and vice president of Columbia Technology Ventures.

Seats filled up fast in Low Rotunda for the symposium's all-day program on big data.

Big **Data,** Big **Ideas**

Columbia faculty and leading data scientists and researchers underscored the ever-increasing challenges and opportunities tied to big data at a symposium held April 5 by Columbia's new Institute for Data Sciences and Engineering. The all-day event featured keynotes by Eric Horvitz, managing co-director at Microsoft Research Redmond, and Lawrence D. Burns, former longtime vice president at General Motors and director of the Program on Sustainable Mobility at the Earth Institute.

Institute Director **Kathleen McKeown** announced four key industry partnerships with Bloomberg LP, Google, Mediaocean, and Microsoft, as well as its new certification program for data sciences, now in the review process. The new program, which comprises four core courses in data sciences, is the first step in the Institute's goal to create a master's degree program and, ultimately, a PhD program in data sciences.

More than 350 guests attended the event in Low Rotunda and some 400 tuned in via webcast. Topics discussed at the "Big Data to Big Ideas" symposium included the potential for technology innovation in data sciences, a boom in job opportunities for those with data-science skills, and the University's interdisciplinary approach in addressing this exciting field.

"We were thrilled that the symposium captured such a large audience, both with in-person attendees and those who watched the live webcast and commented via Twitter and Facebook," said McKeown, who is also the Henry and Gertrude Rothschild Professor of Computer Science at the Engineering School. "The keynotes and panelists really brought data sciences to life, covering the fascinating facets of this important field in far-reaching discussions of its current and future challenges and solutions. The Q & A sessions were very lively and it was exciting to see faculty, industry leaders, students, and our partners come together to focus on the urgent need to understand data sciences now, and how we, at Columbia, are taking a broad interdisciplinary approach to developing solutions that will have an impact on our daily lives. We look forward to working with our industry partners as we move ahead."

In opening remarks, **G. Michael Purdy**, executive vice president for research at Columbia, said that big data "will dramatically change the way we view the world around us," including the way new tools and technologies will be developed going forward and how people will engage with one another. These ideas of change in conducting business, in technology, in education, and in research were constant themes mentioned throughout the day's program.

In his keynote, Eric Horvitz echoed the excitement surrounding big data, and particularly new opportunities in technology innovation. He presented several examples of what Microsoft Research is doing in the area, including analyzing mobile communications and building predictive models based on user data. He also explained the value of citizen science—nonprofessional scientists contributing to scientific research—and its potential to work hand in hand with machine learning techniques to better analyze large datasets.

The data collecting and modeling that is being done now "is still very much in their infancy," said Horvitz. "Three or four decades from now, we'll reflect on earlier work [and think] wasn't that quaint."

Lawrence Burns, who is also a professor of engineering practice at the University of Michigan's School of Engineering, focused his talk on mobility, centering on innovations that are transforming the automotive sector. Before joining Columbia, he spent over a decade as vice president of research and development for General Motors and has long championed the reinvention of the automobile. He gave a thoughtful overview of the major transformations made to "personal mobility," such as autonomous vehicles that drive themselves, shared cars, crash avoidance—all technologies and innovations "driven by data sciences and engineering."

The symposium also featured two panel discussions focused on the Institute's industry partners and the topic of data visualization. During the data visualization panel, **Shih-Fu Chang**, Richard Dicker Professor of Telecommunications and senior vice dean at the Engineering School, showed photos and images posted on social media sites like Facebook, demonstrating how one image can convey emotion. There is a need, he explained, to make sense of visual sentiments from social media, but asked, "How do we organize this in a meaningful structure?" This is just one of several key areas of research the Institute's New Media Center will cover.

In his presentation, **Mark Hansen**, professor of journalism at the School of Journalism and chair of the New Media Center, showed how "data can be a tremendous source of creativity and a tremendous source of story-telling." One example he gave was a public art installation he helped create at Walter Cronkite Plaza at the University of Texas, Austin. A live feed of text extracted from local television news is projected across the square on to a University building. Hansen said such new media artwork reminds us "that data can function in a creative fashion as well."

Patricia Culligan, associate director of the Institute and professor of civil engineering and engineering mechanics, introduced the Institute's Center chairs who gave brief presentations, and she invited the audience to attend a poster session that gave attendees an overview of exciting research currently being conducted in the six centers: Cybersecurity, Financial Analytics, Foundations of Data Science, Health Analytics, New Media, and Smart Cities.

In the industry panel session featuring Bloomberg, Facebook, Google, and Microsoft Research, panelists stressed the value of the interdisciplinary nature of the University-wide Institute and its centers as well as its advantage in being located in New York City, where the technology start-up community is rapidly growing.

"Columbia is uniquely positioned to provide the cross pollination that our industry needs," said **Shawn Edwards** BS'90, MS'95, chief technology officer at Bloomberg who stressed that data science is not just a computer science issue but reaches across many different disciplines.

Jennifer Tour Chayes of Microsoft Research agreed. "Really what Columbia is bringing in is their understanding of so many different domains."

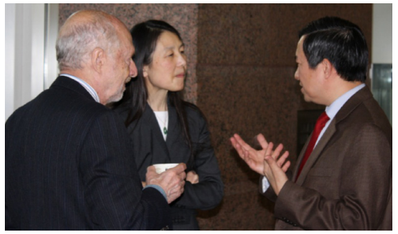
Panelists agreed the field of data science is burgeoning, and Columbia's new Institute is in a good position to bring leadership to data sciences and the City's tech start-up world.

Google CIO Ben Fried shared his envy of the Institute's future graduates. "They are moving into a world where there's so much more need than availability," said Fried who stressed that he's lucky to work at a company that values data, citing that Google already employs data scientists in sales, in finance, and in human resources. "Data scientists are already contributing to the company … To those future graduates, your skills will be much valued."

By Melanie A. Farmer

Professor Zvi Galil, Dean of Computing at Georgia Tech University and former Dean of Columbia Engineering, with Professor Joseph Traub

Hudson Professor of Computer Science Mihalis Yannakakis with student Dimitrios Paparas



Professor Traub with Professor Jeannette Wing, President's Professor of Computer Science and department head at Carnegie Mellon University, and Professor Shih-Fu Chang, Senior Vice Dean and Richard Dicker Professor of Telecommunications

Gussman Professor of Computer Science Al Aho, Professor Richard Karp, director, Simons Institute for the Theory of Computing, University of California at Berkeley, and Anita Jones, University Professor Emerita at University of Virginia

CS Research Scientist Anargyros Papageorgiou with CS Professor Henryk Wozniakowski, who is also professor of applied mathematics at University of Warsaw

Professor H.T. Kung, William H. Gates Professor of Computer Science and Electrical Engineering at Harvard, and Professor Traub

SEAS Celebrates **CS Founding Chair on his 80th Birthday**

Edwin Howard Armstrong Professor of Computer Science **Joseph Traub**

Joseph Traub, Edwin Howard Armstrong Professor of Computer Science, celebrated his 80th birthday in grand style with a number of events, including an all-day symposium held November 9 in Davis Auditorium. The symposium was organized by **Zvi Galil**, former Dean of Columbia Engineering from 1995 to 2007 and currently The John P. Imlay Jr. Dean of Computing at Georgia Institute of Technology; H. T. Kung, William H. Gates Professor of Computer Science and Electrical Engineering at Harvard; and **Shree K. Nayar**, T.C. Chang Professor of Computer Science at Columbia Engineering.

"Each of the speakers has been significant in my professional life," says Traub. "I'm grateful that they could be here for this celebration."

The conference was well-attended and included sessions chaired by Galil; Anita Jones, University Professor Emerita, University of Virginia; and **Shih-Fu Chang**, Columbia Engineering Senior Vice Dean, Richard Dicker Professor of Telecommunications, and Professor of Electrical Engineering and of Computer Science.

"I was honored and happy to take part in the symposium celebrating Joe Traub's 80's birthday," says Galil. "Joe's list of achievements is so long that I will mention only three. He created a thriving scientific area called Information-Based Complexity, he took a small computer science department at Carnegie Mellon University to eminence, where it's now one of the very best, and at Columbia, he created the computer science department almost from scratch. It's now an excellent department, one of very few that have six members of the National Academy of Engineering."

"On a personal level," he adds, "Joe brought me to Columbia in 1982 where I spent 25 years and for which I will be forever grateful."

Traub was head of the Computer Science Department at Carnegie-Mellon University from 1971 to 1979 and founding chairman of Columbia's Computer Science Department from 1979 to 1989. He was the founding chair of the Computer Science and Telecommunications Board (CSTB) of the National Academies from 1986 to 1992 and served again as chair from 2005 to 2009. A member of the Division Committee on Engineering and Physical Sciences (DEPS) of the National Academies, Traub is the author or editor of 10 books and more than 120 journal articles. He is also the editor-in-chief of the *Journal of Complexity* and associate editor of *Complexity*.

Traub's numerous honors include election to the National Academy of Engineering in 1985, the 1991 Emanuel R. Piore Gold Medal from the Institute of Electrical and Electronics Engineers (IEEE), and the 1992 Distinguished Service Award from the Computer Research Association. He is a fellow of the American Association for the Advancement of Science, the Association for Computing Machinery, the New York Academy of Sciences, and the Society for Industrial and Applied Mathematics. He has been Sherman Fairchild Distinguished Scholar at the California Institute of Technology and received a Distinguished Senior Scientist Award from the Alexander von Humboldt Foundation. He was selected by the Academia Nazionale dei Lincei in Rome to present the 1993 Lezioni Lincee, a cycle of six lectures. Traub received the 1999 Mayor´s Award for Excellence in Science and Technology, presented to him by Mayor Rudy Giuliani at a ceremony in New York City. In May of 2001, he received an honorary doctorate of science from the University of Central Florida.

Traub has served as advisor or consultant to the senior management of numerous organizations including IBM, Hewlett-Packard, Schlumberger, Stanford University, INRIA (Paris), Federal Judiciary Center, Defense Advanced Research Projects Agency, National Science Foundation, and Lucent Technologies. In 2008 he was elected to the board of directors of the Marconi Society.

Traub was recently selected as a member of the inaugural class of fellows of the American Mathematical Society (AMS). He was also selected by the National Research Council (NRC) for two significant advisory roles. He was appointed to a second term on the Divisional Committee on Engineering and Physical Sciences (DEPSCOM) of the NRC; he also has chaired a review of the Board on Math Sciences and Applications (BMSA) for the NRC.

Symposium speakers included:

Jeannette M. Wing, President's Professor of Computer Science and department head, Carnegie Mellon University, and former assistant director for Computer and Information Science and Engineering at the National Science Foundation;

Henryk Wozniakowski, professor of computer science, Columbia University and professor of applied mathematics, University of Warsaw;

Ian Sloan, Scientia Professor at the University of New South Wales;

Ralph Gomory, research professor at the Stern School of Business of New York University, president emeritus of the Alfred P. Sloan Foundation, former director of IBM Research, and winner of the 1988 National Medal of Science;

Anita Jones, University Professor Emerita, University of Virginia;

Richard M. Karp, director, Simons Institute for the Theory of Computing, University of California at Berkeley, and 1985 Turing Award winner;

David Lee, director, Networking and Communications Lab, HP Labs, HP;

Anargyros Papageorgiou, research scientist, Columbia University; and

David E. Shaw, chief scientist, D. E. Shaw Research, and senior research fellow, Center for Computational Biology and Bioinformatics, Columbia University.

Hack turns the Cisco **phone on your desk into a remote bugging device**

No fix yet for attack that allows eavesdropping on private conversations.

By Dan Goodin
January 10, 2013

Internet phones sold by Cisco Systems are vulnerable to stealthy hacks that turn them into remote bugging devices that eavesdrop on private calls and nearby conversations.

The networking giant warned of the vulnerability on Wednesday, almost two weeks after a security expert demonstrated how people with physical access to the phones could cause them to execute malicious code. Cisco plans to release a stop-gap software patch later this month for the weakness, which affects several models in the CiscoUnified IP Phone 7900 series. The vulnerability can also be exploited remotely over corporate networks, although Cisco has issued workarounds to make those hacks more difficult.

"Cisco recognizes that while a number of network, device, and configuration based mitigations exist, there is no way to mitigate the physical attack vector on the affected devices," the company's advisory stated. "To this end, Cisco will conduct a phased remediation approach and will be releasing an intermediate Engineering Special software release for affected devices to mitigate known attack vectors for the vulnerability documented in this advisory."

The vulnerability is the latest reminder of privacy threat posed by today's phones, computers, smartphones, and other network-connected devices. Because the devices run on software that is susceptible to hacking, they can often surreptitiously be turned into listening—and sometimes spying—vehicles that capture our business secrets or most intimate moments.

The vulnerability in Cisco phones was discovered by **Ang Cui** and **Salvatore Stolfo**, a doctoral candidate and a computer science professor, respectively, in Columbia University's engineering department. In a talk titled "Just because you are paranoid doesn't mean your phone isn't listening to everything you say" and presented at the 29th Chaos Communication Congress, Cui demonstrated a device that connects to the local serial port of a Cisco phone. Once attached, it injects attack code that gives the attacker control over the devices.

Among other things, the hack allows attackers to monitor phone calls and to turn on the phone's microphone in order to eavesdrop on conversations within earshot and stream them over the network.

Cui demonstrated the vulnerability earlier in December. Cisco issued a patch around the same time, but in his later demonstration, Cui said it was ineffective. Cisco responded with Wednesday's advisory, pledging to rewrite the underlying firmware to "fully mitigate the underlying root cause" of the vulnerability. The advisory said that would happen in the next few months but wasn't more specific.

Cui's hack works by overwriting portions of the user or kernel space in the phone's memory. That allows him to gain root access to the phone's Unix-like firmware system and take control of the digital signal processor and other key functions.

While the hack requires physical access to the phone, it would still be possible for janitors, colleagues, or other trusted insiders to carry out the attack. Once done, a phone exhibits few indications that it has been compromised. It's not uncommon for security-conscious people to place masking tape over the video camera of their computers to prevent drive-by attacks that turn them on. Thwarting attacks that turn phones into bugging devices will be harder, since the phones can't be unplugged during calls. Welcome to the world of network-connected devices.

Reprinted courtesy of Ars Technica

Reading History Through Genetics

"This means that we can now use genetics as an objective source of information regarding history, as opposed to subjective written texts."
– ITSIK PE'ER

Associate Professor
Itsik Pe'er

Computer scientists at Columbia's School of Engineering and Applied Science have published a study in the November 2012 issue of *The American Journal of Human Genetics* that demonstrates a new approach used to analyze genetic data to learn more about the history of populations. The authors are the first to develop a method that can describe in detail events in recent history, over the past 2,000 years. They demonstrate this method in two populations, the Ashkenazi Jews and the Masai people of Kenya, who represent two kinds of histories and relationships with neighboring populations: one that remained isolated from surrounding groups, and one that grew from frequent cross-migration across nearby villages.

"Through this work, we've been able to recover very recent and refined demographic history, within the last few centuries, in contrast to previous methods that could only paint broad brushstrokes of the much deeper past, many thousands of years ago," says Computer Science Associate Professor **Itsik Pe'er**, who led the research. "This means that we can now use genetics as an objective source of information regarding history, as opposed to subjective written texts."

Pe'er's group uses computational genetics to develop methods to analyze DNA sequence variants. Understanding the history of a population, knowing which populations had a shared origin and when, which groups have been isolated for a long time, or resulted from admixture of multiple original groups, and being able to fully characterize their genetics is, he explains, "essential in paving the way for personalized medicine."

For this study, the team developed the mathematical framework and software tools to describe and analyze the histories of the two populations and discovered that, for instance, Ashkenazi Jews are descendants of a small number—in the hundreds—of individuals from the late medieval times, and since then have remained genetically isolated while their population has expanded rapidly to several millions today.

"Knowing that the Ashkenazi population has expanded so recently from a very small number has practical implications," notes Pe'er. "If we can obtain data on only a few hundreds of individuals from this population, a perfectly feasible task in today's technology, we will have effectively collected the genomes of millions of current Ashkenazim." He and his team are now doing just that, and have already begun to analyze a first group of about 150 Ashkenazi genomes.

The genetic data of the Masai, a semi-nomadic people, indicates the village-by-village structure of their population. Unlike the isolated Ashkenazi group, the Masai live in small villages but regularly interact and intermarry across village boundaries. The ancestors of each village therefore typically come from many different places, and a single village hosts an effective gene pool that is much larger than the village itself.

Previous work in population genetics was focused on mutations that occurred very long ago, say the researchers, and therefore able to only describe population changes that occurred at that timescale, typically before the agricultural revolution. Pe'er's research has changed that, enabling scientists to learn more about recent changes in populations and start to figure out, for instance, how to pinpoint severe mutations in personal genomes of specific individuals—mutations that are more likely to be associated with disease.

"This is a thrilling time to be working in computational genetics," adds Pe'er, citing the speed in which data acquisition has been accelerating; much faster than the ability of computing hardware to process such data. "While the deluge of big data has forced us to develop better algorithms to analyze them, it has also rewarded us with unprecedented levels of understanding."

Pe'er's team worked closely on this research with study co-authors, Ariel Darvasi, PhD of the Hebrew University of Jerusalem, who was responsible for collecting most of the study samples, and Todd Lencz, PhD of Feinstein institute for Medical Research, who handled genotyping of the DNA samples. The team's computing and analysis took place in the Columbia Initiative in Systems Biology (CISB).

This research is supported by the National Science Foundation (NSF). The computing facility of CISB is supported by the National Institutes of Health (NIH).

By Holly Evarts

Have Hackers Won?

Professor
Steven M. Bellovin

By Wayne Hanson
September 12, 2012

GT: Three years ago you said buggy code is the oldest unsolved problem in computer science, and that you expected it to remain that way. Is that still your viewpoint three years later? It seems that as our infrastructure becomes "smarter" we will become a much bigger target for the bad guys, with potentially much more dangerous consequences. One failed traffic light at a busy intersection, for example, can snarl vehicles for miles.

Yes, I still think that. Exactly what to do is still a research area; while I have some ideas, they're not even to the half-baked stage yet. I think we need to build systems with different architectures, ones that are designed under the realization that there will be security failures. Authentication won't do it—in most breaches, the bad guys go around the strong authentication, not through it.

My own working philosophy is that programs will have security bugs—then what? But that's a research agenda, not guidance I can give to a programmer, let alone an end site. You cite the failed traffic light, and you're absolutely right—what is the fallback position when a component fails?

Why is buggy code such an intractable problem?

Fundamentally the issue is the intellectual difficulty of managing the complexity of programs. Take, for example, the Thunderbird mail program. When I checked a few years ago, it was about 6 million lines of code. (That's a very rough estimate; I'm confident about the "millions" part, but much less confident that it's 6 million as opposed to 3 million or 12 million.)

Suppose I want to write some code concerning how the number of attachments is displayed in the summary line. That section of code will have to interact with the vastly complex code that looks at the entire message and parses it to see exactly where each attachment starts and ends. (That code itself is of mind-boggling complexity, because the specifications are so complex.) Do I understand the other code correctly? Will I do something wrong because I don't understand it? How many attachments can there be? Suppose I look at the code today and realize that it can't handle more than 99 attachments, so I allow for a two-digit field to display. Sometime later, someone else comes along and—not knowing what I did—changes the code to allow for 9,999 attachments. My code can't handle it, so there's now a bug. Is it exploitable by a hacker? Possibly, possibly not —but that's how these things can start.

A better design would have been for the attachment-handling code to have some way to tell another part of the program what the limit is, but that would have implied a great deal of foresight. Sometimes programmers have enough, sometimes they don't—or they might have [in the past], but requirements change over the years.

Beyond that, there is sometimes carelessness. I'll dredge up a story from about 35 years ago, when I was in grad school and teaching introductory programming. For complicated but understandable reasons, one student put a semicolon into an operating system command. (This was an IBM mainframe, back in the punch-card days.)

Semicolons were necessary in the program but forbidden in the command language. However, the person who programmed that part of the command language wasn't expecting a semicolon, so when this command showed up—that is, every time they tried to run this student's deck of punch cards—it crashed the entire mainframe. The student wasn't very popular, but the fault was really the programmer's—he should have written his code better, to avoid crashing the system when someone submitted garbage like semicolons.

Programs today are a lot better, but they're far from perfect. You may have heard the phrase "SQL injection attack—it's a problem that occurs when programmers don't cope with unexpected inputs. (*http://xkcd.com/327/* makes the point in a humorous way.)

The problem is that other than "write better code," there aren't great ideas on what to do about the complexity problem. (The "I forgot" problem is somewhat more tractable.) Now, "write better code" can be very helpful. Microsoft has spent vast sums of money in the last decade on that, ranging from programmer education, to automated checking tools, to code review teams. It's helped; it's helped tremendously, but—as witnessed by [Microsoft's] rate of critical bug fixes—they're still far from where they'd like to be. There also are lots of ideas on how developers can write better code, but I've been watching panaceas show up since at least the early 1970s. Needless to say, the problem isn't solved yet.

Does IPv6 offer fewer vulnerabilities?

It offers some minor advantages, but nothing major. Back when we were designing it, we had higher hopes. In fact, circa 1994 the claim was made that it would be more secure. Unfortunately that statement is, as they say, "inoperative" for several reasons. First, what we mean by "more secure" was really "built-in cryptography"—what we now call IPsec, a VPN (virtual private network) protocol.

There are several problems with that. For one thing, we have a better understanding today of the causes of insecurity. Crypto is a great thing, but it's not going to solve the buggy code problem. (In 1998, as part of a National Academies study, I analyzed every CERT advisory issued up to that point. 85% of them described problems that encryption couldn't fix: code problems, configuration errors, etc.). Second, we assumed that IPv6 would be deployed a lot more quickly than has turned out to be the case. In the interim, every shipping operating system has added IPsec support to its IPv4 code. That negates the advantage that IPv6 was supposed to have.

There are still some benefits: privacy-enhanced addressing is one; the relative immunity of a v6-only net to scanning worms—ones that spread by trying to find all hosts in a given range of IP addresses—is another. These are minor advantages, though, and have to be balanced against ISP and [system administrator] relative inexperience with IPv6 operation and tracing. (By the latter, I mean answering the question "which host did that nasty thing?" when the host is using a privacy-enhanced address and hence isn't easily identifiable unless you take other precautions.)

So if buggy code and the problems you mentioned will remain, where do we go from here?

Just because there's no such thing as perfect, it doesn't mean there isn't 'better' versus 'worse.' Good practices can go a long way to help—but don't assume that they've solved the whole problem.

Reprinted courtesy of Digital Communities, available at http://www.digitalcommunities.com/articles/Have-Hackers-Won.html

Professor Bellovin Named **FTC's Chief Technologist**

Computer Science Professor **Steven M. Bellovin** has been appointed Chief Technologist by Federal Trade Commission Chairman Jon Leibowitz. His was one of four appointments announced today.

"I'm really excited about becoming Chief Technologist of the Federal Trade Commission," said Bellovin, who will advise the agency on evolving technology and policy issues. "The FTC, among its other roles, helps ensure that companies keep their promises about security and privacy, two areas that I've been working on for many years. I look forward to seeing how I can contribute."

Bellovin has taught computer science at Columbia since 2005. During more than 20 years at Bell Labs and AT&T Labs Research, he focused on network security firewalls, protocol failures, routing security, and cryptographic protocols. Bellovin is a member of the National Academy of Engineering and holds an M.S. and Ph.D. in Computer Science from the University of North Carolina at Chapel Hill, and a B.A. from Columbia University. On September 4, 2012, he will replace Edward W. Felten, who is returning to Princeton University and will consult for the FTC.

"The Federal Trade Commission has a history of having the best and brightest work here, and we are continuing that tradition of excellence with these appointments," Leibowitz said, adding, "We are fortunate that we have had so many talented individuals at our agency, and incredibly lucky that we will continue to benefit from the tremendous expertise of former OPP Director Susan DeSanti and outgoing Chief Technologist Ed Felten in their new positions."

By Holly Evarts

Professor Sethumadhavan **Wins Sloan Fellowship**

Associate Professor
Simha Sethumadhavan

Professor **Simha Sethumadhavan** has been selected as an Alfred P. Sloan Foundation Research Fellow for 2013.

Simha Sethumadhavan, Associate Professor of Computer Science, has been selected as an Alfred P. Sloan Foundation Research Fellow for 2013. He is among 126 outstanding U.S. and Canadian researchers who will each receive $50,000 for use in their work.

"I am very happy to have received such an honor," said Sethumadhavan. "This recognition means a lot to me, and will help run my exploratory research in making computers run more efficiently and securely."

An expert in computer hardware and security, Sethumadhavan directs the Computer Architecture and Security Technology Lab at Columbia Engineering, where he works on improving computer security with hardware enhancements and making them more energy-efficient with a model he calls "analog-digital hybrid computing."

Sethumadhavan hopes to change the way people think about computer security, raising it from an afterthought to a priority. "Current security measures have largely overlooked the benefits of hardware enhanced security," he noted, "and are mostly oriented to top-down design where the most exposed layers of the system, the network/application layers, are first studied with the assumption that the lower layers are secure, even when they are not. The lack of a holistic view of security urgently needs to be addressed if we are to improve overall security of systems."

Sethumadhavan, who joined Columbia Engineering in 2008, received an NSF CAREER award in 2011. He earned his BSE from the University of Madras, and his MS and PhD from the University of Texas at Austin.

"The Sloan Research Fellows are the best of the best among young scientists," said Dr. Paul L. Joskow, president of the Alfred P. Sloan Foundation. "If you want to know where the next big scientific breakthrough will come from, look to these extraordinary men and women. The Foundation is proud to support them during this pivotal stage of their careers."

Awarded annually since 1955, the Sloan Fellowships are given to early-career scientists and scholars whose achievements and potential identify them as rising stars, the next generation of scientific leaders. They are nominated by their fellow researchers and chosen by a distinguished panel of senior scholars.

The 2013 Sloan Research Fellows were drawn from 61 colleges and universities across the United States and Canada and represent a wide range of research interests in eight scientific fields—chemistry, computer science, economics, mathematics, evolutionary and computational molecular biology, neuroscience, ocean sciences, and physics.

By Holly Evarts

Professor Kim **Wins NSF Award** to Track Software Energy Consumption

Professor **Martha Kim** has won a National Science Foundation CAREER award to develop energy tracking and monitoring techniques to audit and control software energy consumption.

Assistant Professor
Martha Kim

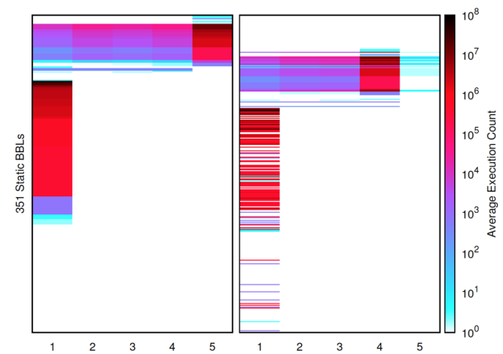
Computer Science Assistant Professor **Martha Kim** has won a National Science Foundation (NSF) CAREER award to develop energy tracking and monitoring techniques to audit and control software energy consumption. The CAREER Award, one of the NSF's most prestigious awards that honors exceptional junior faculty, will support Kim's research with a $420,000, five-year grant.

"I am honored by this recognition from the NSF, and very excited to pursue this line of research," says Kim, who directs the ARCADE Lab. "We're trying to track how much energy different pieces of software consume, whether they're different applications running on your cell phone, or different parts of a single application like image capture versus image processing on your phone's camera app. Right now there's no way to do this, so we're eager to move this research forward as it will help software designers, system engineers, and even end users control their energy consumption."

Energy is one of the most critical resources in a modern computer system, Kim notes.

"Excessive consumption on a mobile phone and the resultant short and unpredictable battery life is universally annoying while excess consumption in a data-center like Amazon's can hurt a business's bottom line and damage equipment creating potential service outages."

Kim hopes her research will enable programmers to debug their energy consumption by tracking down energy bugs the same way they track performance bugs, allow systems running third-party software to track the applications that are draining batteries and either kill the apps or offer an option to do so, and help cloud-computing providers bill clients according to their energy usage.



Parallel application profiles, such as the ones above, indicate that applications do not consume energy uniformly, motivating the fine-grained energy management techniques to be developed as part of the CAREER project.

"Right now these third-party software apps, like the ones on our phones, run unchecked and then we're unpleasantly surprised by their suddenly poor battery life," says Kim. "In fact, 70% of phones returned to Motorola in 2011 were due to battery-life complaints caused by third-party software."

"And billing clients for their specific energy consumption," she adds, "will more accurately reflect the cost of hosting a particular job and make that market a lot more efficient."

Another goal of Kim's research is closely tied to her teaching and advising activities—she is looking to weave parallel reasoning into the foundational courses of the computer science curriculum and to explore how to best train students to write energy-efficient code and software.

"The next generation of computer scientists must be fluent in these concepts to design and develop responsible software that runs faster and at lower energy cost," says Kim. "Energy is becoming one of the most critical resources in a computing system—indeed, computer systems are facing more stringent and complex energy management scenarios than ever before. So it's really critical to understand energy efficiency, to know how software will interact with hardware, and to carefully debug and control energy consumption."

Professor Carloni **Wins 2012 IEEE CEDA Early Career Award**

Associate Professor
Luca Carloni

Computer Science Associate Professor **Luca Carloni** has received the Early Career Award from the IEEE Council on Electronic Design Automation (CEDA) for seminal contributions to system-level design, including latency-insensitive design, on-chip communications synthesis and compositional design-space exploration.

Professor Luca Carloni's research interests include methodologies and tools for multi-core system-on-chip platforms with emphasis on system-level design and communication synthesis, design and optimization of networks-on-chip, embedded software and distributed embedded systems. He received the Laurea Degree Summa cum Laude in Electronics Engineering from the University of Bologna in Italy, and a Master of Science degree in Engineering and a Ph.D. in Electrical Engineering and Computer Sciences from the University of California at Berkeley.

CEDA's Early Career Award honors an individual who has made innovative and substantial technical contributions to the area of EDA in the early stages of his or her career. Contributions are measured by technical merit and creativity in performing research and assessed on the published record of the individual and the references accompanying the nomination. The award is equally available to contributors from academic and industrial institutions.

Professor Keromytis Named **ACM Distinguished Scientist**

Associate Professor
Angelos Keromytis

The Association for Computing Machinery (ACM) has named Computer Science Associate Professor **Angelos Keromytis** a Distinguished Scientist.

"It's a gratifying recognition of my work and my record by external peers," says Keromytis, who is also the director of Columbia's Network Security Lab.

He is an expert in systems security, network security, and cryptography. Currently, Keromytis is working on software hardening, system self-healing, network denial of service, information accountability, and privacy.

Most security systems are designed to keep bad guys out, and can do little once they are inside, Keromytis explained in a 2011 profile on his research. "We want the computer to recognize an attack, see what happens, and come up with a way to modify the system so that it blocks the attack," he said.

Initiated in 2006, ACM's Distinguished Member Recognition Program recognizes those members with at least 15 years of professional experience who have made significant accomplishments or achieved a significant impact on the computing field. Recipients of this honor include computer scientists and engineers from leading corporations, research labs, and universities who made significant advances in technology that are having lasting impacts on the lives of people across the globe.

By Jeff Ballinger

Professor Stein Named **Prestigious ACM Fellow**

Professor
Clifford Stein

Clifford Stein, Professor of Industrial Engineering and Operations Research (IEOR) and of Computer Science, has just been named an ACM (Association for Computing Machinery) Fellow. He is one of 52 ACM members recognized for their contributions to computing that are fundamentally advancing technology in health care, cybersecurity, science, communications, entertainment, business, and education.

"I am honored to receive this recognition and to be joining such a distinguished set of fellow nominees," says Stein, who also chairs the IEOR Department.

Stein's research is focused on the areas of combinatorial optimization, scheduling, and network algorithms. He specializes in algorithms that estimate the answer to problems that are difficult to solve, like ones in operations research and computer science that grow significantly more complex as the number of inputs grows. He studies the fundamental structure of problems to develop new algorithms, and has recently been developing innovative ways to apply scheduling to computer processors in order to save energy.

"These men and women are advancing the art and science of computing with enormous impacts for how we live and work," said ACM President Vinton G. Cerf of the new class of fellows. "The impact of their contributions highlights the role of computing in creating advances that range from commonplace applications to extraordinary breakthroughs, and from the theoretical to the practical. Some recipients have also helped to broaden participation in computing, particularly among underrepresented groups, and to expand its impact across multiple disciplines."

Stein, who joined Columbia Engineering in 2001, was elected chair of the IEOR Department in July 2008. He becomes the seventh ACM Fellow at the School, joining Alfred V. Aho (1996), E. G. Coffman (1994, Lifetime Member), Kathleen McKeown (2003), Joseph F. Traub (1994), the late David L. Waltz (1999), and Mihalis Yannakakis (1998).

Stein has published many influential papers in the leading conferences and journals in his field, and has occupied a variety of editorial positions. His work has been supported by the National Science Foundation and Sloan Foundation. He is the winner of several prestigious awards, including an NSF Career Award, an Alfred Sloan Research Fellowship, and the Karen Wetterhahn Award for Distinguished Creative or Scholarly Achievement. *Introduction to Algorithms*, which he co-wrote with T. Cormen, C. Leiserson, and R. Rivest, has sold more than 500,000 copies and is currently the best-selling textbook in algorithms.

It has been translated into over 15 languages.

Stein and his fellow 2012 honorees, who exemplify the highest achievements in computing research and development from the world's leading universities, corporations, and research labs, will be formally recognized at ACM's annual Awards Banquet on June 15, 2013, in San Francisco, CA. Additional information about the ACM 2012 Fellows, the awards event, as well as previous ACM Fellows and award winners is available at *www.acm.org/awards*.

ACM is the world's largest educational and scientific computing society, uniting computing educators, researchers, and professionals to inspire dialogue, share resources, and address the field's challenges. The ACM Fellows Program, initiated in 1993, celebrates the exceptional contributions of the leading members in the computing field.

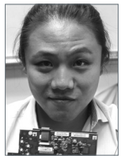
By Holly Evarts

Professor **Alfred Aho** addressed Dennis Ritchie Tribute at Bell Labs. The memorial celebration is titled "The Lasting Legacy of Dennis Ritchie: The Impact of Software on Society". The video is available at *http://youtu.be/GfoSbffSIQ4*.

Aaron Bernstein received the Best Student Paper Award at STOC 2013, the 45th ACM Symposium on the Theory of Computing, for his single-authored paper titled "Maintaining Shortest Paths Under Deletions in Weighted Directed Graphs." The work is on maintaining distance information in a network that is changing over time. STOC is one of the most prestigious conferences in theoretical computer science. Two papers shared this award at STOC 2013.

Professor **Shih-Fu Chang** was named Richard Dicker Professor of Telecommunications. Professor Chang is a pioneer and leader in the vibrant field of multimedia. He has been recognized with many technical awards and best paper awards for inventing novel systems that combine content analysis, multimedia retrieval, and mobile communication. Ranked by Microsoft Academic Search as one of the most influential researchers in the field of multimedia, he has also received the 2011 ACM SIGMM Technical Achievement Award and 2009 IEEE Kiyo Tomiyasu Award. Many of his video retrieval technologies have been licensed to companies. He is a fellow of the IEEE and the American Association for the Advancement of Science.

Professor **Michael Collins** was selected as a Faculty Finalist in the New York Academy of Sciences' 2012 Blavatnik Awards for Young Scientists, for making fundamental advances in machine learning and natural language processing.



Ang Cui won International Cup special prize from the Kaspersky Lab student conference 'IT Security for the Next Generation', for his work titled "Killing the Myth of Cisco IOS Diversity: Recent Advances in Reliable Shellcode Design".

Dr. **David Harmon**

Dr. **David Harmon**, **Etienne Vouga**, **Breannan Smith**, Rasmus Tamstorf (Walt Disney Animation Studios) and Associate Professor **Eitan Grinspun**'s paper "Asynchronous Contact Mechanics" was selected as a Research Highlight for the April 2012 issue of Communications of the ACM. Their method was the first to provably guarantee three desirable properties about colliding objects: that no objects ever interpenetrate, that the objects obey laws of physics like conservation of energy and momentum, and that the algorithm finishes in a finite amount of time.

Etienne Vouga

Breannan Smith

Assoc. Professor **Eitan Grinspun**

YoungHoon Jung

Richard Neill

Assoc. Professor **Luca Carloni**

YoungHoon Jung, **Richard Neill**, and their advisor Associate Professor **Luca Carloni** received the Best Paper Award for their work "A Broadband Embedded Computing System for MapReduce Utilizing Hadoop" presented at the 4th IEEE International Conference on Cloud Computing Technology and Science (CloudCom 2012). The work was selected among the fifty-four papers accepted to the conference, which had a 17% acceptance rate.

Dr. Kristen Parton

Dr. **Kristen Parton**, Dr. **Nizar Habash** and Professor **Kathy McKeown** won a Best Paper Award at EAMT 12 (Conference of the European Association for Machine Translation) for their paper entitled "Can Automatic Post-Editing make MT more Meaningful?". In this research, they built automatic post-editors that can detect and correct errors made by machine translation (MT) systems. They focused on errors that most affect the translation's meaning, such as mistranslated names or words that the computer didn't translate at all. Human-judged evaluations showed that the automatic post-editors significantly improved MT adequacy across two different MT systems and two kinds of test data. This paper presents research done by Kristen Parton for her dissertation.

Dr. Nizar Habash

Professor **Kathy McKeown**

Vasilis Pappas

Dr. Michalis Polychronakis

Assoc. Professor **Angelos Keromytis**

Vasilis Pappas won the first prize in the Kaspersky Lab North American Round at NYU-Poly CSAW, for his paper "Smashing the Gadgets: Hindering Return-Oriented Programming Using In-Place Code Randomization" coauthored with Dr. **Michalis Polychronakis** and Associate Professor **Angelos D. Keromytis**. The paper was accepted earlier in IEEE Symposium on Security and Privacy, 2012. He now goes to the International Round, in London.

Evangelia Sitaridi

Professor **Kenneth Ross**

Evangelia Sitaridi and her advisor Professor **Kenneth Ross** won the Best Paper Award at DaMoN 2012, collocated with SIGMOD, for their paper "Ameliorating Memory Contention of OLAP Operators on GPU Processors," which seeks to exploit the special structure of GPUs to increase the performance of data processing operations. In particular, they show how to optimize data arrangement in GPU memory using redundancy in order to minimize the running time of data processing operators implemented on a GPU.

Christos Vezyrtzis

Professor **Steven Nowick**

Professor **Yannis Tsividis**

Christos Vezyrtzis and his co-advisors Professor **Steven Nowick** (CS) and Professor **Yannis Tsividis** (EE), won a Best Paper Award in the Logic and Circuit Design track at the 30th IEEE International Conference on Computer Design (ICCD-12). The paper is entitled "Designing Pipelined Delay Lines with Dynamically-Adaptive Granularity for Low-Energy Applications." The paper presents work led by Christos Vezyrtzis for his dissertation. It provides a novel approach to significantly reducing energy in delay lines, which are core components in several emerging signal processing systems.

Lauren Wilcox received a Dissertation Award from the Agency for Healthcare Research and Quality. Lauren's work addresses an important gap in health information technology: there has been limited research to date that explores the impact of providing hospitalized patients with direct access to health information throughout their care. Her research will yield new insights into how such technology can be used to educate and engage hospitalized patients and their families, by developing tablet-computer-based user interfaces with which hospitalized patients and their families can review clinical and health-related information. It will advance scientific knowledge in the field of patient-clinician communication, demonstrate new technical capabilities for sharing information among patients and their care team, and explore potential improvements to patient engagement, knowledge, and satisfaction.

Lisa Wu

Asst. Professor **Martha Kim**

Assoc. Professor **Stephen Edwards**

Lisa Wu, Assistant Professor **Martha Kim**, and Associate Professor **Stephen Edwards**' paper "Cache Impacts of Datatype Acceleration" was selected as the Spotlight Paper for the January–June 2012 issue of the IEEE Computer Architecture Letters.

In Memoriam
David L. Waltz
CCLS Director

David L. Waltz, director of the Center for Computational Learning Systems (CCLS) at Columbia Engineering and prominent computer scientist, passed away March 22, 2012 at a hospital in Princeton, N.J. He was 68.

Waltz joined Columbia in 2003 as director of CCLS, an interdisciplinary research center established to focus on leading-edge machine learning and data mining research. CCLS colleague Roger Anderson, a senior research scholar, said he is "terribly saddened for Dave's passing, and proud to have served under his vision, integrity and strength of leadership."

Waltz received his Ph.D. from the Massachusetts Institute of Technology, where his thesis on computer vision originated the field of constraint propagation. According to the story, "Early Warning for Seizures", in the Fall 2009 issue of *Columbia Engineering Magazine*, he is also well known as the originator, along with former colleague Craig Stanfill, of the memory-based reasoning branch of Case-Based Reasoning.

Prior to joining Columbia, Waltz was president of the NEC Research Institute in Princeton, and from 1984-1993 served as Director of Advanced Information Systems at Thinking Machines Corporation and a professor of computer science at Brandeis University. He had also been professor of electrical and computer engineering at the University of Illinois (CSL and ECE Department) for eleven years. Waltz served as president of AAAI (American Association for Artificial Intelligence) from 1997-1999, and was a Fellow of AAAI and ACM (Association for Computing Machinery), a senior member of IEEE (Institute for Electrical and Electronics Engineers), and former chairman of ACM SIGART (Special Interest Group on Artificial Intelligence).

Waltz served on several boards, including the Army Research Lab Technical Advisory Board and the Advisory Board of the Florida Institute for Human and Machine Cognition, the Technical Advisory Board of 4C (Cork Constraint Computation Center, Ireland), and more recently on external advisory boards for Rutgers University, Carnegie-Mellon University, Brown University, and EPFL (Ecole Polytechnique Federale de Lausanne). He was also on the Advisory Board for IEEE Intelligent Systems, the Computing Community Consortium Board of the CRA (Computing Research Association), and NSF Computer Science Advisory Board.

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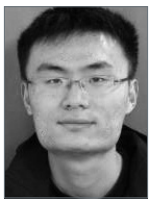
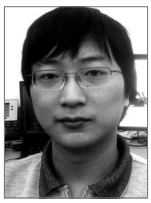
Extra News

CS@CU Won First Place at the ACM ICPC Greater New York Regional Contest


Long Chen


Gang Hu


Xinhao Yuan


Xiaorui Sun

After a grueling five-hour competition, the CS@CU team won the first place at the ACM ICPC Greater New York Region programming contest, and will advance to the ACM ICPC World Finals, to be held in St. Petersburg, June 2013. Team members include **Long Chen**, **Gang Hu**, and **Xinhao Yuan**, and the team is coached by **Xiaorui Sun**. ACM ICPC is the oldest, largest, and most prestigious programming contest in the world. Each year, more than 5,000 teams from 2,000 universities all over the world compete at the regional level, and about 100 teams advance to the World Finals. Congratulations! and good luck in St. Petersburg!