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MAGAZINE 2013, VOLUME II



LLVM: The World's Compiler

Developed by CS @ ILLINOIS

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click! Magazine is produced twice yearly for the friends of CS @ ILLINOIS to showcase the innovations of our faculty and students, the accomplishments of our alumni, and to inspire our partners and peers in the field of computer science.

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A computer once beat me at chess,
but it was no match for me
at kick boxing.

Emo Philips

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“ Some
breakthrough
science
is already
happening... ”



We have many exciting things to share in this issue of *click! Magazine*, but they are just a glimpse into the amazing depth and breadth of talent that our faculty, students, and alumni possess.

The cover article focuses on LLVM, a remarkable achievement in the compiler world, from CS @ ILLINOIS. Professor Vikram Adve and former PhD student Chris Lattner (MS CS '02, PhD '05) shared the prestigious ACM Software Systems Award for this work, which has become the foundational compiler ecosystem for pretty much everybody, everywhere: Apple, Google, Intel, NVIDIA, Qualcomm, Cray, etc. This is only one of the many awards our faculty and students have won recently.

And speaking of faculty: we have made several exciting new hires this year, in areas ranging from software engineering to Big Data and crowdsourcing, improving on our traditional strengths and positioning us for the future.

Also new to campus: the largest supercomputer owned and operated by any university on the planet. Blue Waters came on line earlier this year, featuring nearly 800,000 x86 cores, over 13 petaflops, and an amazing high-performance storage/interconnect system. Some breakthrough science is already happening: our faculty contributed to a recent effort that was featured on the cover of *Nature*, helping to decode the atomic-level structure of the HIV virus.

There are way too many things to summarize in this brief introduction, so I think I should just encourage you to start reading—and please let us know what you think.

Rob A. Rutenbar, Head

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MARC Andreessen: Queen Elizabeth Prize for Engineering

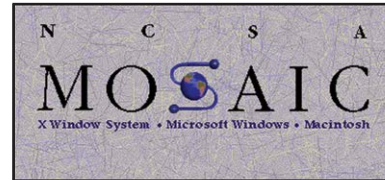
Marc Andreessen (BS CS '94) was named one of the inaugural recipients of the Queen Elizabeth Prize for Engineering. Seen by many as a Nobel Prize for Engineering, the award recognizes and celebrates "outstanding advances in engineering that have changed the world."

Andreessen was co-author of Mosaic, the first widely used web browser. Together with Eric Bina (BS CS '86, MS '88), Andreessen founded Netscape, one of the first major Internet companies, which marketed the Netscape Navigator Browser.

In 2009, Andreessen and Ben Horowitz, who had worked with Andreessen at Netscape, took what they had learned about being entrepreneurs and running startups and co-founded Andreessen Horowitz. Since that time, Andreessen Horowitz has grown to become one of the major venture capital firms in the technology

field. They have provided funding for such companies as Box, Facebook, Foursquare, Groupon, Pinterest, Skype, Twitter, Udacity, and Zynga.

Andreessen joins four other Internet pioneers—Sir Tim Berners-Lee, Vinton Cerf, Robert Kahn, and Louis Pouzin—in sharing the one million pound prize. The award was announced March 18 at the Royal Academy of Engineering and was presented to the recipients by Queen Elizabeth II at a ceremony held June 25.



MARY JANE Irwin: College of Engineering Alumni Award

Mary Jane Irwin (MS CS '75, PhD '77) received an Alumni Award for Distinguished Service from the College of Engineering. She was recognized "for outstanding research, leadership, and service contributions to computer science and engineering, and for outstanding efforts to increase the participation of women in the field."

A leading faculty member at Penn State since 1977, Irwin currently holds the title of Evan Pugh Professor as well as the Robert E. Noll Chair in Engineering in the Department of Computer Science and Engineering.

Irwin was one of the first researchers in computer architecture to predict that energy would become

the next important constraint for high-performance system developers. To address these challenges, she led the creation of the first architectural-level power simulator to optimize power consumption and facilitate an energy-aware design approach. In addition to being a pioneer in computer science, Irwin has been a strong advocate for women in engineering.

Irwin received her BS in mathematics from Memphis State University. She received an honorary doctorate from Chalmers University in Sweden. CS @ ILLINOIS awarded her the Distinguished Alumni Achievement Award in 2011, and she currently serves on the CS Alumni Advisory Board.



THOMAS M.
Siebel:
Recognized by
the American
Academy
of Arts and
Sciences
and the
University of
Illinois Alumni
Association

BY BILL BELL, COLLEGE OF ENGINEERING

In a speech last year, Thomas M. Siebel (BA HIS '75, MBA '83, MS CS '85) discussed some of the people "who really made a difference. Thomas Jefferson... and Steve Jobs... Sally Ride and Margaret Thatcher... Martin Luther and Martin Luther King." He described them as "people who were unusually sensitive to what was going on around them. They heard things that other people could not hear. They saw things that others could not see."

The American Academy of Arts and Sciences (AAAS) annually recognizes people who see things that others can't see, and this year Siebel received the prestigious honor of election to AAAS. Siebel founded and grew Siebel Systems into the world's largest customer relationship management software company. It was purchased by Oracle in 2005.

Siebel is currently the chairman and chief executive officer of C3 Energy, a software company that helps utility companies realize the full promise of their investments in smart grid technologies.

He is one of the world's top philanthropists, having created The Siebel Foundation. Through the foundation, 85 Siebel Scholars are selected each year, based on outstanding academic performance and leadership. They receive a \$35,000 award toward their final year of graduate studies. Five members of the 2014 class of Siebel Scholars are from CS @ ILLINOIS.

The Meth Project, which Siebel also founded, improves education, scholarship, community life and the prevention of teen drug use. He also continues to generously support the university, where he established the Thomas M. Siebel Center for Computer Science and endowed two chaired professorships. At Illinois, he earned a bachelor of arts degree in history in 1975, a master's degree in business administration in 1983, as well as a master's degree in computer science in 1985. In 2006, he received an honorary doctorate of engineering.

"Tom is a remarkable alum, a deeply creative thinker on problems both technical and social. He's spectacularly adept at turning a big idea into a compelling vision and marshaling people to execute on it," said Rob A. Rutenbar, head of CS @ ILLINOIS. "We're thrilled the academy recognized his incredible contributions to America and the world. And we're confident there are many more to come."

One of the nation's most prestigious honorary societies—it includes over 250 Nobel laureates, and more than 60 Pulitzer Prize winners—the AAAS is also a leading center for independent policy research. Members contribute to academy publications and to studies of science and technology policy, energy and global security, social policy and American institutions, and the humanities, arts and education.

In addition, Siebel was recognized recently by the University of Illinois Alumni Association with the Alumni Achievement Award. This award, established in 1957, is the highest honor that the Alumni Association bestows.



ROBERT Horst: IERA Award for AlterG Bionic Leg

BY MARK PAJOR, ECE ILLINOIS

Robert Horst (MSEE '78, PhD CS '91) of AlterG Inc. won the 9th annual Invention and Entrepreneurship Award in Robotics and Automation (IERA) for the Tibion Bionic Leg, now called the AlterG Bionic Leg. The AlterG Bionic Leg is a wearable robotic mobility assistance device. Under the direction of physical therapists, it is used by patients with impaired mobility to strengthen stance, improve gait, and enhance active motor learning.

Horst's device won the award for being a "breakthrough product for rehabilitation of stroke patients at an affordable price, offering a compelling story of an entrepreneurial journey with typical ups-and-downs culminating in a successful business," according to the citation for the award.

The initial idea for the bionic leg came to Horst when he had knee surgery in high school. "I just felt there was a need for new technology for assistance devices. We were still using walkers, and crutches and canes, and we aren't



making very much use of new technology," Horst said. In 2001, after gaining significant experience in the industry, Horst returned to that idea and began research. In the following year, he and a partner officially started Tibion Corporation.

Horst explained how the concept evolved from an always-on aid to a physical therapy device that would have lasting impact for self-reliant walking. "The original idea was to make an assistance device that would be worn by the patient all the time. But then once we finally developed the device, we found that it was very effective for physical therapy. It wasn't useful just when they were wearing the device, but when they take it off, they would be walking much better."

There were challenges along the way to success for Horst's product. One of those challenges was acquiring funding. "Probably the major challenge was always funding, because we started in right after the dot-com bust in 2001. And then we went all the way through the big financial meltdown in 2008."

Founded in 2002 by Horst and Kern Bhugra, Tibion Incorporated sold the first Bionic Leg in 2009. The company has sold more than 100 units to hospitals, physical therapy facilities, and nursing facilities. Tibion is now part of AlterG Inc., a company that is revolutionizing modern rehabilitation. The Bionic Leg was the 2005 Grand Prize Winner in the Boomer Business Plan Competition, the 2008 winner of the Silicon Valley Emerging Technology Award for Medical Devices, and the 2010 winner of the Medical Design Excellence Awards competition.

Horst was recognized by ECE as a distinguished alumnus in 1998. He is credited with several pioneering contributions in the architecture and fault tolerance fields. Horst is now AlterG's chief technology officer of robotics, and he continues to lead development on the AlterG Bionic Leg.

“At Every Peak the View Is Different”: Geomagic Founder Gives Engineering Convocation Address

BY TOM MOONE

Ping Fu (MS CS '90) was the featured speaker at the 2013 College of Engineering Convocation in May. Fu was the co-founder and CEO of Geomagic, a leader of 3D imaging software. In early 2013, Geomagic was acquired by 3D Systems Corporation, and Fu now serves as vice president and chief strategy officer of 3D Systems.



Fu told the students the story of how she grew up during the Cultural Revolution in China before making her way to the U.S. to study. She originally intended to study comparative literature in the U.S. However, because her English was poor, she decided to go into computer science as an alternative. “I realized that writing software code and writing essays are all writing, instead of writing essays on montage, I was writing code for the future not yet imagined,” said Fu in her speech to the graduates and their families.

That realization helped transform her future. She soon landed a job at the National Center for Supercomputing Applications (NCSA). The atmosphere she found there was exhilarating “I was not experiencing just one transformative technology. I was experiencing all of them,” she said of her time at NCSA. Being at NCSA in the early 1990s meant being present at the birth of the Internet as we know it.

In 1997 Fu saw a demonstration of an early 3D printer. “I was instantly hooked,” said Fu. “This is not just about sharing data anymore. This is about using data to make stuff. How interesting that would be.”

Based on that experience, Fu founded what would become Geomagic, a software company that was intended to reinvent engineering and manufacturing from a desktop.

It is the excitement of starting this company and becoming involved in the cutting edge technology that Fu wanted to share with the students. “And seeing all of you here, I invite all of you to join me in manufacturing our future,” she said. “The possibilities are limitless and are only limited by our imaginations.”

Fu ended her address with a recognition that her struggles in growing up during a difficult period in Chinese history, coming to a new country to study, and starting her own company are what helped shape her future and her career success. “I wish always for a bright future and interesting journey,” she said. “But don’t discard the power of your life’s struggle and the wonderful places that those circumstances can lead. Life is a mountain range. At every peak the view is different. And sometimes you have to go down to go up.”



Examples of items created with a 3D printer, including an edible sugar cube.

Industry Giants, Home for Many CS Alumni, Host Networking Events

BY LEANNE LUCAS





Facebook and Microsoft were the hosts for joint Computer Science/Electrical and Computer Engineering alumni events held earlier this year. The departments invited current student leaders to join the trip as well. Four CS and two ECE students traveled

to Facebook headquarters in Menlo Park, California, and Microsoft headquarters in Redmond, Washington, to meet alumni employed by the two industry giants. Over 350 people attended these events, including 250 Illinois alumni and 116 CS graduates.

Cole Gleason, a junior and a member of the Association for Computing Machinery (ACM), attended the trip to Facebook. While there he was able to meet with Dean Nelson, vice president of data information at eBay. "Nelson took the time to meet with students and was interested in learning what student groups were working on. We can always use more contact between industry experts and undergraduates," said Gleason.

Gleason also talked with Dave Paola (BS CS '10), CTO at Bloc. Paola said, "I know Cole through ACM already, and I hold him in high regard. I think that's the part of this event that I enjoyed the most—connecting with these students and also with alumni I hadn't seen in a while."

Emily Tran, a junior and vice president of Women in Computer Science, attended the trip to Microsoft. "I was able to reconnect with alumni who were seniors when I first came to Illinois. Seeing how successful they were was inspiring. And they had great tips on what to do and what not to do during our time at Illinois. That was very helpful," said Tran.

Fernanda Richnak (MS CS '10), a program manager at Microsoft, said, "I met up with the students for an informal chat about what it's like to work here on a day-to-day basis. They learned more about the products we're working on and how we're applying concepts we learned in school. For example, I do a lot of user interface design as part of my job, and I still use concepts that I learned in CS 465 [Principles of User Interface Design, Implementation and Evaluation]."

Arpit Agarwal, a CS graduate student and Siebel Scholar studying multimedia systems and human-computer interactions, also went on the Microsoft trip. Agarwal said the alumni event was a great way to find a role model and to better envision how to proceed with his career. "Illinois graduates are respected across the industry. To be able to speak with people who are in industry for a period of time is a good thing," he said. "I hope to see myself in their shoes in a couple of years."

“ I do a lot of user interface design as part of my job, and I still use concepts that I learned in CS 465. ”

—Fernanda Richnak (MS CS '10)

VMWare Launches Log Insight After Acquisition from CS @ ILLINOIS Founders

BY BILL BELL, COLLEGE OF ENGINEERING

VMWare officially launched its Log Insight cloud analytics platform in September, but that came only after more than 6 years of work by a team of CS @ ILLINOIS alumni. Log Insight is the brainchild of Pattern Insight, a company founded by CS @ ILLINOIS graduates Zhenmin Li, Spiros Xanthos, Bo Q. Zhu, and former CS Professor Yuanyuan “YY” Zhou.

It was a Big Data play spun out of CS @ ILLINOIS before Big Data was cool, and Log Insight was acquired by VMWare last year.

In 2005, Pattern Insight’s founders published a set of papers on methods of mining and analyzing the vast code bases that make up today’s information technology and engineering software tools and solutions. Industry-leading companies took notice, and the team founded their company, now known as Pattern Insight, the next year.

Other CS @ ILLINOIS alumni—including Erik Hinterbichler, Chengdu Huang, Weihang Jiang, Xiao Ma, Ramses Morales, Jay Patel, Matt Ronge, Sameer Sundresh, and Jed Taylor—also helped build Pattern Insight.

“Our vision has always been to change how people search, mine, and analyze their vast amounts of IT and Engineering data,” said Pattern Insight’s former CEO Spiros Xanthos.

The team started the Log Insight platform because as “cloud computing and virtualization make IT environments more efficient, infrastructure and applications also grow larger and more complex,” said Xanthos. “The need to rely on data to manage them and make better decisions becomes even more pressing. Log Insight combines analytics and log management technology and has the ability to analyze vast amounts of machine-generated data in real time and lead administrators to the root cause of problems very quickly.”

After the acquisition of Log Insight, members of the engineering team joined VMWare to continue the development of that technology.



Meanwhile, the company Pattern Insight continues to thrive. Customers for its Code Insight suite of tools include Intel, Qualcomm, Motorola, EMC, and Tellabs, according to the tech publication *The Register*. It is used to find code errors, survive code crashes, and analyze code crashes after the fact.

Pattern Insight’s products help companies improve the quality of their software code. Bo Q. Zhu, vice president of products at Pattern Insight, said “We discovered early on that large companies in the networking and telecom industries were managing billions of lines of code and when they fixed a bug in one branch of code they did not know where else that bug fix needed to be applied. In seconds—not hours—we can show them everywhere in their code base that a patch needs to be applied, even if the code base has been modified.”

As for YY Zhou—now the Qualcomm Endowed Chair at the University of California, San Diego—she is working on her next startup Whova (whova.com), a big data analytics tool providing professional people search.

The Pattern Insight team in July 2008 (l to r): Mark Silva, Erik Hinterbichler (MS CS '08), Zhenmin Li (PhD CS '06), Alan Bricker, Gita Gupta, David Majnemer (BS CS '11), Weihang Jiang (PhD CS '09), John Lovitt, Nick Berens, Jed Taylor (MS CS '03, MBA '05), Nate Sanders, Spiros Xanthos (MS CS '07), Yuanyuan Zhou (former CS professor), Sanjeev Kumar, Chengdu Huang (PhD CS '07), and Bo Q. Zhu (PhD CS '07). Left Inset: Xiao Ma (MS CS '07, PhD '12).

LLVM, Starting Out as a Research Project, Hits the Big Time

BY DEB ARONSON

Vikram Adve, professor of computer science, and his first-year graduate student, Chris Lattner, made a plan for their next project. It was not a big plan, just the kind of plan a professor and a graduate student make all the time in the course of their research.



"We had talked about the idea of developing an infrastructure to use for both dynamic and static compilation, which we were going to work on after winter vacation," remembers Adve.

Apparently, Lattner's idea of vacation was to write code, because in January, 2001, when he returned from his Banks, Oregon home, Lattner had a rough prototype of what would eventually become LLVM.

"I still remember him walking into my office and wanting to show me something," says Adve. "It was a pleasant surprise."

That prototype included a lot of the key design elements of what would become LLVM, says Adve. LLVM originally stood for "low level virtual machine," but as LLVM has expanded its capabilities it has left that acronym behind and is known only by its initials.

Lattner's approach involved building a modular infrastructure that could be put together in many different ways to build compilers and other tools.

"Developing a compiler is a huge effort, so having one that you could use for all languages saves a lot of effort," says Adve. LLVM's virtual instruction set is the "secret sauce, the crux of its being able to do so many languages, whether static, scripting or managed," Adve adds.

Lattner had been deeply steeped in computing since he was a child.

"I had been interested in programming from a very young age, starting with basic programming on the Commodore VIC-20 computer when I was in elementary school," says Lattner, who has a bachelor's degree in computer science from the University of

Portland. "I had a fascination with getting the machine to do what I wanted it to, and was always the sort of person that liked taking things apart and rebuilding them. Plus I just really love programming and solving hard problems, and compilers require both."

"I had no idea how good he was," says Adve, referring to those early days. "He is single-handedly responsible for the elegance and cleanliness of the LLVM architecture, as well as much of the code."



But neither Adve nor Lattner could have appreciated at the time just how big LLVM would grow.

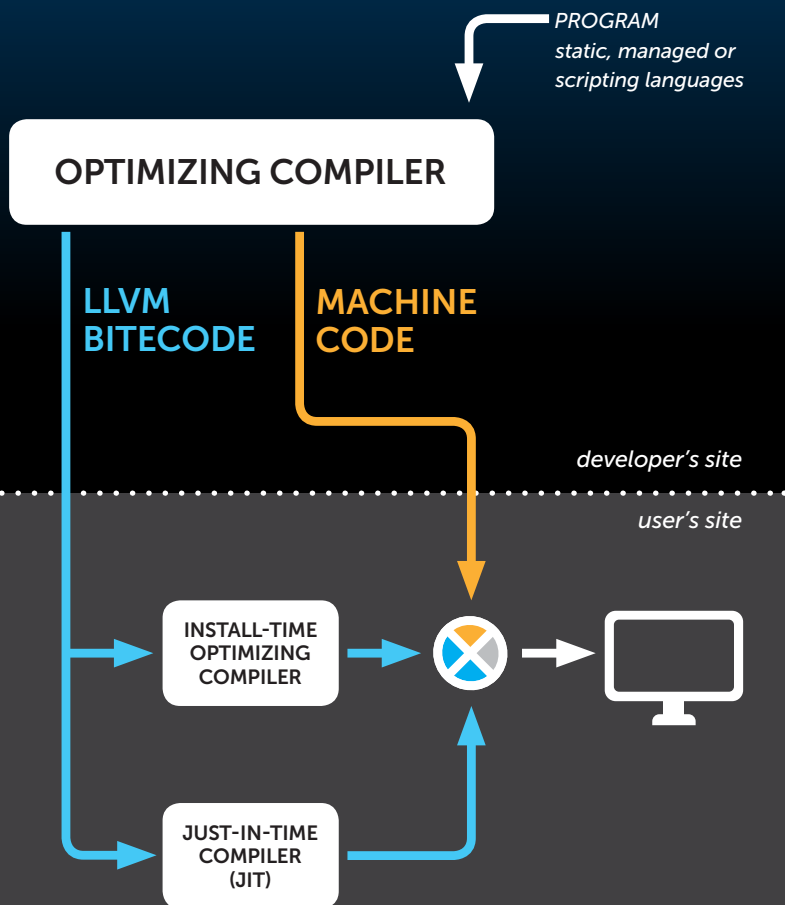
This year, exactly a decade after LLVM was first released to the public, Lattner and Adve were awarded the prestigious ACM Software System Award. The award is given to an institution or individual(s) that has developed a software system with lasting influence, reflected in contributions to concepts, in commercial acceptance, or both.

The award is given to a single software system, worldwide, each year. Yet this is the second time a tool developed at the University of Illinois has won the award. In 1995, Marc Andreessen and Eric Bina also

*Professor Vikram Adve
and Chris Lattner
(MS CS '02, PhD '05)*

LLVM Low Level Virtual Machine

Unifies compilation for ALL families of languages



received the ACM Software System Award. Working together at NCSA they developed the web browser Mosaic, which is generally credited with sparking the World Wide Web revolution.

Begun as a research project, LLVM is now used by many leading software companies worldwide. Although the average user is not aware of it, LLVM is integral to both the iPhone and the Android. Sony uses LLVM to compile code for PlayStation. Cray uses it to build software for supercomputers, including Blue Waters, the petaflop-scale system at the University of Illinois. Google also uses LLVM for all its internal software.

This year, a story in *Wired* described LLVM as the only thing Apple and Google still have in common, and called LLVM “a piece of technological brilliance” that “is changing the way we build and run computer software—any computer software.”

While others had tried to solve the problem, with varying degrees of success, LLVM’s approach lies in its much more basic language. It has much less information specific to a given programming language, which makes it closer to machine code and more universal.

LLVM “is a way to effectively bury the compilation element of a language interpreter below the application layer where the runtime module normally resides, deep into object code,” Scott Fulton III wrote in *Betanews*.

There are other solutions like LLVM, but none are as robust, well supported, and flexible. In addition, LLVM has a very liberal open source license. That means that companies can adopt it for use in their proprietary programs and not worry about giving away clues about

that program or proprietary hardware for which their compiler is used.

"It is one thing to develop a research infrastructure, but it's another to make one robust enough and clean enough for companies to use," says Adve.

Today LLVM has become a primary compiler at Apple, Qualcomm, NVIDIA and Cray.

"That is a very big deal," says Adve. "The compiler is a linchpin piece of software. Replacing the compiler system is a much deeper change than you could imagine, especially for a major company with a large portfolio of software tools."

Not only are companies using LLVM, but researchers are also using it, something that gratifies Adve and Lattner deeply. LLVM has been used in software research including architecture, compilers, software security, and silicon compilation.

Lattner, who has worked at Apple since 2005, continues to grow and support LLVM.

"LLVM has been a lot of work, and required a lot of dedication," says Lattner, who was honored with a Distinguished Alumni Achievement award from the Department of Computer Science this year. "For me, I look at LLVM as a collection of small successes, and take pride with each small achievement that I personally contributed to along the way. I really just like building useful things, and like seeing a well designed system come together."

Wired calls LLVM
"The One Last Thread
Holding Apple and
Google Together":
<http://wrd.cm/19nYpW6>



CS @ ILLINOIS is Ground Zero When it Comes to Compilers



David J. Kuck

David Kuck, then a member of the computer science department, was the first person, and only professor, working on software architecture on the ILLIAC IV project, one of the first attempts to build massively parallel computers and to apply autoparallelization to compilers.

Kuck (pronounced "Cook"), among other University of Illinois computer scientists, built the first "vectorizing compiler," allowing the machine to operate efficiently on the array-structured data that dominates in scientific computing tasks. His pioneering techniques are incorporated in every optimizing compiler in use today.

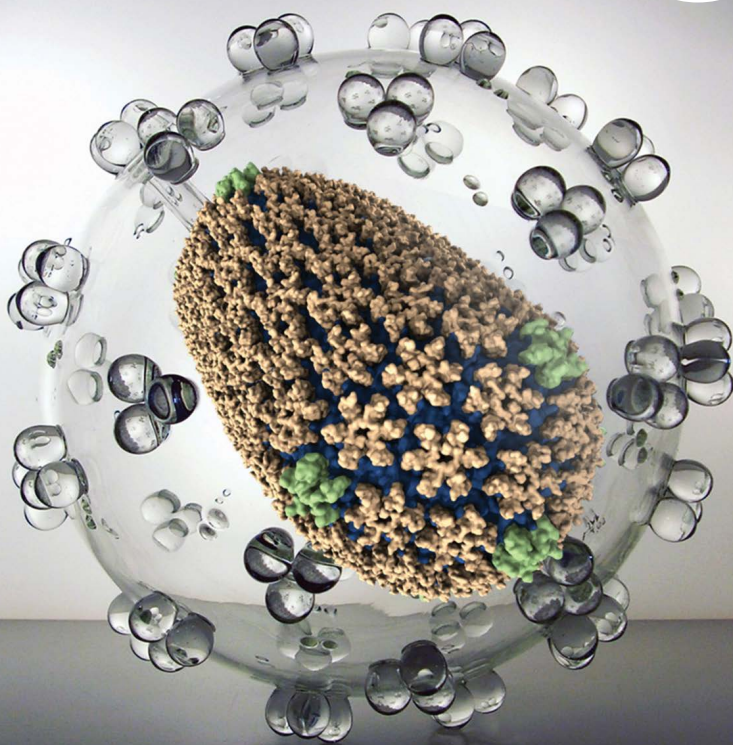
His influence has been both theoretical and practical. Kuck developed many of the initial ideas for how to restructure computer source code for parallelism and also trained many other leaders in the field, including David Padua, professor of computer science, Constantine Polychronopoulos, professor of electrical and computer engineering, and Duncan Lawrie, former department head of computer science.

Kuck went on to lead the CEDAR supercomputing project at Illinois, and created a startup, Kuck and Associates, Inc. (KAI), to deliver commercial versions of these optimizing compilers. Intel Corp. bought KAI in 2000, and it became the nucleus for the Intel R&D site located locally in Champaign. Kuck, an emeritus faculty in computer science, is now an Intel Fellow, and leads the hardware/software co-design R&D effort.

Breakthrough:

Illinois Simulation Software Contributes to Understanding HIV Capsid

BY TOM MOONE



An atomic model of the HIV-1 capsid.

Recent research that has revealed, for the first time, the atomic structure of the HIV capsid was accomplished using simulation software developed at the University of Illinois. A decades-long collaboration involving CS Professor Laxmikant “Sanjay” Kalé and Physics Professor Klaus Schulten has centered on developing state-of-the-art software tools for biomolecular modeling. NAMD (NANoscale Molecular Dynamics) was first developed by Kalé, Schulten, and co-workers nearly 17 years ago.

The capsid is the protein shell of the HIV virus, the exterior “coating” that encloses its genetic material. Using NAMD, Schulten and his colleagues determined and illustrated the detailed structure of the HIV capsid—research that was featured on the cover of the journal *Nature*.

Researchers throughout the world use NAMD to simulate biological machinery at the atomic level on parallel supercomputers and clusters. This scalable software enables simulations of very small molecular systems of the size from a few hundred thousand atoms to larger ones with a hundred million atoms. “At that level, you can actually see how various biological phenomena happen,” said Kalé.

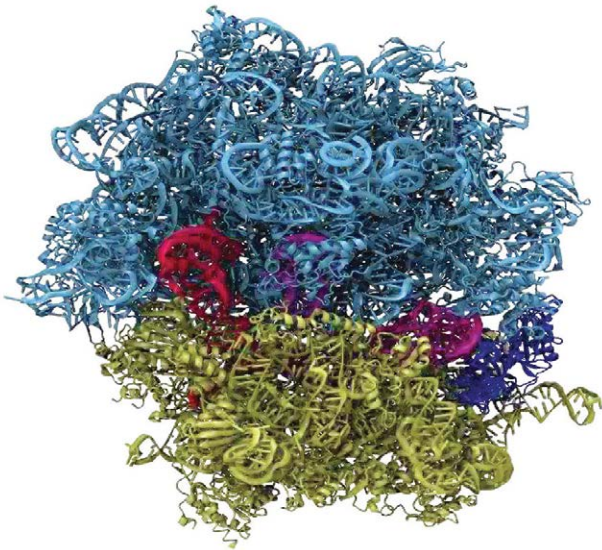
Computationally, NAMD involves an atom-by-atom simulation that uses classical molecular dynamics. So there are a large number of small computations at every time step. “The challenge is to simulate millions of time steps where the amount available for parallelizing is the computation of only one time step,” said Kalé.

NAMD is written using Charm++, a parallel programming system developed by Kalé’s Parallel Programming Laboratory. Charm++ is likewise nearly 20 years old and has evolved in conjunction with NAMD. “We leverage the features of Charm++ to make NAMD an effective, scalable program,” said Kalé. “At the same time, NAMD influences the design of newer features in Charm++. So they kind of co-evolved.” Jim Phillips, from Schulten’s research group, is the lead developer of NAMD. The NAMD development team includes many students and staff from Kalé’s group.

See this research
featured in *Nature*:
<http://bit.ly/1hDO6am>



Researchers throughout the world use NAMD to simulate biological machinery at the atomic level on parallel supercomputers and clusters.



Over the years, NAMD has become very popular with researchers. “Its design has stood the test of time over all these years,” said Kalé. “When we began we were working on a small cluster of HP workstations, to now when we can run it on several hundred thousand processors.”

Kalé and his research group regularly update NAMD and Charm++ with new capabilities and to ensure performance on new machines and systems. Vendors of parallel machines also consult with Kalé’s research group. “When parallel machine vendors sell a new machine, their customers want to be sure that NAMD works well on the machines,” said Kalé. “So those companies come to us for help, whether it be IBM or Cray or NVIDIA.”

As scientific modeling has progressed, a need has grown for larger and larger computers to enable the simulations needed by researchers. When the National Science Foundation first called for proposals for a petascale computing system (a call that led to

the current Blue Waters facility on the University of Illinois at Urbana-Champaign campus), one of the conditions for a successful proposal was to demonstrate scalable performance using NAMD.

When Blue Waters was ready to run NAMD, there were several challenges that Kalé and his team had to address. Performance bottlenecks were discovered, and some memory issues had to be overcome. “This happens all the time,” said Kalé. “For every new machine, for every new scale, you have to overcome new challenges. It can be like a game of Whac-A-Mole.”

Breakthroughs such as the recent HIV capsid results make the years of effort worthwhile for Kalé and his team. “This shows how computer science research, driven by applications needs, can develop something that can have an impact,” he said.

In 2002, NAMD received the Gordon Bell Award. “The Gordon Bell Award is one of the prestigious awards in parallel computing,” said Kalé. “They are given each year to a program that demonstrates maximum performance in some fashion.” In 2012, Kalé and Schulten received the IEEE Computer Society Sidney Fernbach Award “for outstanding contributions to the development of widely used parallel software for large biomolecular systems simulation.”

Kalé is co-PI of the Theoretical and Computational Biophysics group in the Beckman Institute. This group, an NIH Center for Macromolecular Modeling and Bioinformatics, is led by Schulten and has been in existence for more than 20 years.



Professor Sanjay Kalé



Professor Klaus Schulten

Health Information Technology Center

The Health Information Technology Center (HITC) is a University of Illinois inter-campus initiative that aims to develop research partnerships between faculty, physicians, and researchers with the University of Illinois and other healthcare providers. HITC will leverage the strengths of all the partners in an effort to help solve healthcare delivery and cost issues.

HITC's goals are to generate publicity for existing health IT research, build community across the Illinois campuses, provide access to large patient groups and data, and generate new funding and possible commercial ventures.

Led by CS Professor Carl Gunter, HITC is an interdisciplinary and multicampus research center, with researchers coming from the Urbana-Champaign and Chicago campuses of the University of Illinois. Research projects cover such areas as privacy, assured information sharing, electronic security, access management, and industrial design of medical devices.

Learn more about HITC and its research projects at <http://healthit.illinois.edu>



THaW

Trustworthy Health and Wellness



Professors Carl Gunter, Roy Campbell and Klara Nahrstedt

CS faculty Carl Gunter, Roy Campbell and Klara Nahrstedt have been awarded a \$10 million Frontier Award by the National Science Foundation (NSF) to fund a project titled Trustworthy Health and Wellness (THaW).

Frontier Awards go to large, multi-institution projects that address and heighten the visibility of grand challenge research areas in science and engineering with broad economic and scientific impact. THaW was the largest of three awards given out nationally this year by the Secure and Trustworthy Cyberspace (SaTC) program at NSF. "Cybersecurity is one of the most significant economic and national security challenges facing our nation today," said Farnam Jahanian, NSF's assistant director for computer and information science and engineering (CISE), in the release announcing the awards.

Gunter is a co-PI on the interdisciplinary project, which includes faculty from Dartmouth College, John Hopkins, University of Michigan, and Vanderbilt University. The research team includes experts from computer science, business, behavioral health, health policy, and healthcare information technology. The team's areas of expertise include many key aspects of healthcare, such as population and behavioral health and the economics of healthcare as well as computer technology areas like security, privacy, clouds, and mobile devices.

The mission of THaW is to enable the promise of health and wellness technology by innovating mobile- and cloud-computing systems that respect the privacy

New Project will Enhance Cybersecurity of Clouds and Mobiles in Healthcare

BY TOM MOONE



of individuals and the trustworthiness of medical information. Areas of attention will include usable authentication and privacy tools, trustworthy control of medical devices and effective methods to detect malware, compute trust metrics and audit medical information systems and networks. In the long term, this project will help create health systems that can be trusted by individual citizens to protect their privacy and by health professionals to ensure data integrity and security. THaW will also train the next generation of computer scientists by creating courses and sponsoring summer programs for undergraduate and K-12 students and by developing an exchange program for postdoctoral fellows and research students.

At Illinois, the researchers will work through the Health Information Technology Center (HITC) (see sidebar). "The University of Illinois has a growing reputation for incorporating computer science techniques into the health arena," said Gunter, the director of

HITC. "We are uniquely positioned to provide expertise in security and privacy for clouds and mobiles in this Frontier Award project. THaW will build on other successful efforts at UIUC like the HHS SHARPS program, the UIUC/Mayo Alliance, and the Cloud Computing Testbed."

The Illinois team brings unique talents to the project. Gunter, through his work with HITC, brings in a specialty in privacy and security as it relates to healthcare. Campbell and Nahrstedt are experts in cloud and in mobile computing, respectively. Together they bring a breadth and depth to THaW that will ensure success.

In one part of THaW the Illinois researchers will be developing methods that could be employed to develop a cloud-based repository of genomic information controlled by individuals for their personal genomic data based on a technology called "Genomic Personal Health Record (GPHR)." This will enable individuals to support their

care with genomic information as they choose (a process sometimes known as "individualized medicine") and share data for research or recreation using secure methods to be developed by THaW. Another part of THaW to be pursued by Illinois researchers will develop secure techniques for managing health information with cell phones. Current cell phone software is not secure enough for critical medical applications, but security protections can be improved to enable the convenience of mobile health technologies. THaW will develop forensic techniques for auditing mobile technologies that interface with medical records to track down problems and limit risks to safety and security caused by errors and compromises.

Learn more about THaW and its projects at <http://thaw.org>



THaW partners include:



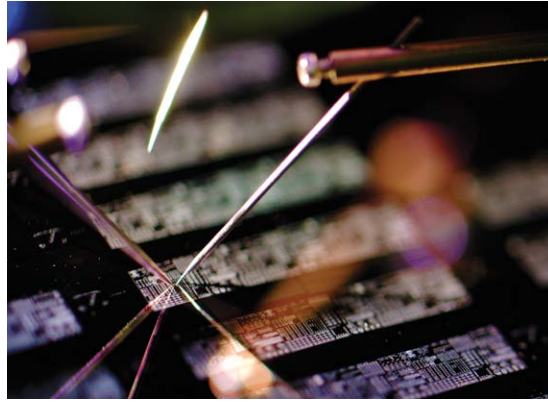


SONIC Center Awarded \$30 Million

BY KIM GUDEMAN, COORDINATED SCIENCE LAB



Led by faculty at the University of Illinois at Urbana-Champaign, a multi-university research team has received \$30 million to launch the Systems On Nanoscale Information fabriCs (SONIC) Center. The center will focus on substantially enhancing the information processing power and storage capacity of integrated circuits (ICs) and related systems, which is critical in maintaining reliability as devices continue to shrink and improve in energy efficiency. Support comes from a new \$194 million initiative called the Semiconductor Technology Advanced Research network (STARnet), which is administered by the Semiconductor Research Corporation (SRC) and funded through a public-private partnership between DARPA and U.S. semiconductor and supplier companies.



Society is increasingly dependent on electronic information and has come to expect electronic devices to decrease in cost, offer more features and provide longer-lasting battery power. In the past, such advances have been made possible by the frequent reduction in size of a basic building block—the transistor switch.

Today, however, these switches are so small that their behavior is fraught with uncertainty due to quantum effects. The challenge is to design reliable and energy-efficient computing systems using these unreliable switches. SONIC's research agenda addresses this issue by treating the problem of computing using unreliable devices and circuits as one of communicating information over unreliable channels.

"Essentially, we're not going to try to build a reliable switch, but instead discover methods to build reliable systems," said SONIC Director Naresh Shanbhag, the Jack S. Kilby Professor of Electrical and Computer Engineering. "While information resides at the highest level and nanoscale components at the lowest level, they can both be mathematically described with the same statistical framework. No one has successfully captured this similarity between them before."

"As Moore's law nears its inevitable end, it's essential to

figure out how we can make reliable computations work on the statistically 'messy' nanoscale circuit fabrics that will come next," says Rob A. Rutenbar, Head of the Department of Computer Science. "The SONIC team is perfectly poised to solve these tough problems." Rutenbar, a member of the SONIC Executive Committee, was the founding director of one of the predecessor SRC/DARPA centers, the \$40 million C2S2 Center, which focused on design issues at the end of conventional circuit scaling.

SONIC seeks to create a new computing paradigm to extend scaling of nanoscale devices beyond what is feasible today. By borrowing probabilistic techniques from the field of communications, SONIC researchers will transform these systems into statistical information processors that infer intent and handle uncertainty while consuming much less energy than traditional computers.

The SONIC team consists of 23 faculty researchers from universities across the nation, including Carnegie Mellon University; Princeton University; Stanford University; the University of California, Berkeley; the University of California, San Diego; the University of California, Santa Barbara; and the University of Michigan. Other Illinois faculty include Pavan Kumar Hanumolu, and Rakesh Kumar, Electrical and Computer Engineering; and John A. Rogers, Materials Science and Engineering.



Professors Naresh Shanbhag and Rob A. Rutenbar

Learn more about the SONIC Center:
<http://www.sonic-center.org>

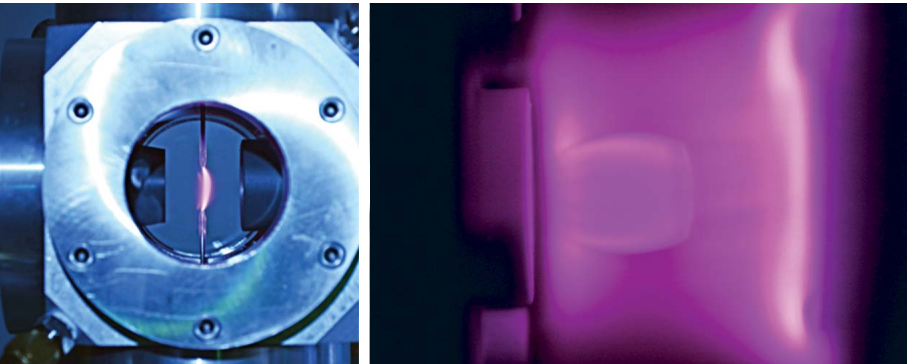


“The SONIC team is perfectly poised to solve these tough problems.”

—Professor Rob A. Rutenbar

Illinois Launches Center for Simulating Plasma-Controlled Combustion

BY KIM GUDEMAN, COORDINATED SCIENCE LAB



The University of Illinois at Urbana-Champaign will receive \$16 million to fund a new center that will leverage extreme-scale computing to predict how plasmas could be used to control combustion. The research may pave the way for cleaner-burning combustors and more reliable and higher performance jet engines.

The Center for Exascale Simulation of Plasma-Coupled Combustion will be funded for five years by the National Nuclear Security Administration, part of the U.S. Department of Energy. The center, one of three Multidisciplinary Simulation Centers funded through NNSA's Predictive Science Academic Alliance Program II, comprises researchers from Illinois and the Ohio State University.



Professor William Gropp

"This would be a whole new mode of managing combustion," said Professor William Gropp, the principal investigator on the grant and director of Illinois' Parallel Computing Institute, which administers

the new center. "We aim to make breakthroughs in this emerging field at the basic science level that ultimately lead to a greener world."

In a normal combustion event, many steps occur between the spark and the firing of an engine. Control

of the intermediary steps is not possible with current technology. However, plasma—a gas that is transformed into a new state of matter when its atoms are ionized—has properties that enable intervention at intermediary steps. Plasma can create the same chemical species that occur during normal combustions and also can produce heat during the different phases, making the chemical process happen faster.

By using plasmas as a control mechanism, researchers believe they can manage the chemical process, thereby reducing emissions of greenhouse gases into the environment. Plasmas could also help stabilize flames for hypersonic, high-speed jet engines, in which air passes through so fast that the flame can be extinguished.

But understanding just how to manage plasma is a difficult problem, requiring three-dimensional fluid computer simulations that can cover many space and time scales. To make reliable predictions, researchers need scalable computational resources to model and analyze the physics components, which range from flow turbulence to electrodynamics.

"You have to be able to understand what's happening at the atomic scale all the way up to the bulk flow in the plasma, which you can measure with a ruler," said Gropp, the Thomas M. Siebel Chair in Computer Science at Illinois. "We can't do this as one big computation, so we have to create new techniques that will help us stitch everything together."

The efforts will include the development of new technologies for heterogeneous petascale and exascale systems. Computer scientists and engineers will create better tools for managing efficient data structures, mitigate the irregularities that come with both extreme-scale computing and the fluid nature of the chemical processes, develop novel computational and programming tools for mapping hardware architectures, and design simulation models specifically for turbulence,

combustion, plasma dynamics and the electro-chemical properties of surfaces.

The Center is part of the Coordinated Science Laboratory, a multidisciplinary research laboratory in Illinois' No. 5-ranked College of Engineering and home to the Parallel Computing Institute. The center is a joint initiative between the Lab and Illinois' Computational Science & Engineering program, with CSE efforts led by Professor Jonathan Freund, who will orchestrate the simulations.

"This work will uniquely combine multiphysics, multiscale analysis and uncertainty quantification and advance the state-of-art in all of these areas," said Professor Narayana Aluru, director of the computational science and engineering program. "We are also excited that this Center will further the educational mission of the University of Illinois through the training of new graduate students in CSE and the development of new computational and engineering courses."

The Illinois researchers hail from aerospace engineering, chemistry, computational science and engineering, computer science, electrical and computer engineering, and mechanical science and engineering. The Ohio State investigators are experts in plasma-assisted combustion, kinetics and experimental diagnostic techniques.

"The Center brings together two areas of expertise—high performance computing and physics-based modeling—that are synonymous with the excellence of our campus," said Illinois Provost Ilesanmi Adesida. "The Center will contribute immensely to predictive science in combustion and beyond."

Nahrstedt Named Acting Director of the Coordinated Science Laboratory

BY RICK KUBETZ, COLLEGE OF ENGINEERING



Klara Nahrstedt, the Ralph M. and Catherine V. Fisher Professor in the Department of Computer Science, will serve as acting director of the Coordinated Sciences Laboratory (CSL).

"I am very pleased that Professor Nahrstedt has agreed to lead CSL at this time," said Andreas Cangelaris, dean of the College of Engineering at Illinois. "As a leading researcher for the College, for CSL, and the Information Trust Institute, she is a natural choice to carry on the work of our most successful units."

Nahrstedt is a leading researcher in multimedia systems, with seminal contributions to quality-of-service (QoS) management for distributed multimedia systems. As a researcher at the Information Trust Institute's Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) Center, she is also looking at how competing QoS and security demands can both be answered in the context of critical cyber-physical systems, such as the power grid. The Information Trust Institute, the Advanced Digital Sciences Center, and the Parallel Computing Institute are major research units within CSL.

Nahrstedt joined the Illinois faculty in 1995 and has received numerous honors, including the IEEE Communications Society Leonard G. Abraham Prize, the IEEE Computer Society's Technical Achievement Award, the University Scholar Award, and the Humboldt Research Award, among others. She is a Fellow of the IEEE and ACM, and she chaired the ACM Special Interest Group on Multimedia from 2009 until earlier this year.

As acting director, Nahrstedt leads CSL while its current director, William Sanders, serves as the Interim Head of the Department of Electrical and Computer Engineering at Illinois.



TEC

Workshop Ignites Entrepreneurial Fire in CS Students

BY LEANNE LUCAS

Excitement for entrepreneurship and a willingness to learn from successful alumni are two of the key requirements for students interested in the Silicon Valley Entrepreneurship Workshop hosted by the College of Engineering's Technology Entrepreneur Center (TEC). Students chosen for the workshop spend a week over winter break in Silicon Valley, the undisputed birthplace of some of today's most innovative and successful startups.

According to Jed Taylor (MS CS '03, MBA '05), assistant director of TEC, and an organizer of the annual trek west, "The goal of the trip is not to push our students to Silicon Valley by any means. The goal is to introduce them to successful alumni who were in their shoes five, six, even ten years ago, and inspire them to find their passion and come back and do something great."

This past January, twenty-five students traveled to Santa Clara Valley. They were a select group—more

than 140 applicants vied for the opportunity to take part in the five-day workshop to visit startups, leading technology companies and venture capital firms.

Twenty of these students came from the College of Engineering; nine majored in computer science. Gavin Owens, a senior in CS, was one of six undergraduates from the department to make the trip. "I met like-minded people," said Owens, "and I made lasting connections with fellow entrepreneurs."

Students also learned that many of the entrepreneurs they met had failed again and again before becoming successful. What set them apart was the relentless pursuit of their entrepreneurial vision.

A number of CS alumni, some who made the same trip during their time at Illinois, hosted the students in their homes and at their offices. Some of those alumni included:

- Roger Dickey (BS CS '05), a startup investor who was the creator of Mafia Wars and a former GM at Zynga.
- Pete Koomen (MS CS '06), co-founder of Optimizely, a startup that helps companies A/B test different versions of their websites. Koomen and his partner, Dan Siroker, have written a book titled *A/B Testing: The Most Powerful Way to Turn Clicks Into Customers*.
- Dave Paola (BS CS '10), and Hani Sharabash (BS CS '11), co-founders of Bloc, an online education platform that connects students with mentors in 12-week web-development courses.
- Joel Poloney, co-founder of Red Hot Labs, a company which develops mobile games and underlying platform technology. Poloney and his partner, Amitt Mahajan (BS CS '06), were among those behind the creation of Zynga's FarmVille, a social game played by millions of users everyday around the globe.
- Anand Raghuraman (MS CS '03), a software engineer at BloomReach, leads various efforts related to mobile product discovery, personalization, location-aware services, social sharing and surfacing of trends.

The wealth of knowledge these alumni shared included how to find your passion, the ins and outs of building a successful startup, and the day-to-day experience of life in a startup. Students also learned that many of the entrepreneurs they met had failed again and again before becoming successful. What set them apart was the relentless pursuit of their entrepreneurial vision.

Taylor said it was important for TEC to choose students who would benefit most from the experience. "When we interviewed students, we asked them, 'Why



CS Junior Yusuf Sobh learns valuable startup lessons from Pete Koomen (MS CS '06), co-founder of Optimizely.

are you entrepreneurial? What do you want to get out of the trip? Why should we take you?' You find out a lot when you ask those questions, and it made it easier to decide not only who would benefit the most, but who would represent us well, and who would come back and inspire other students."

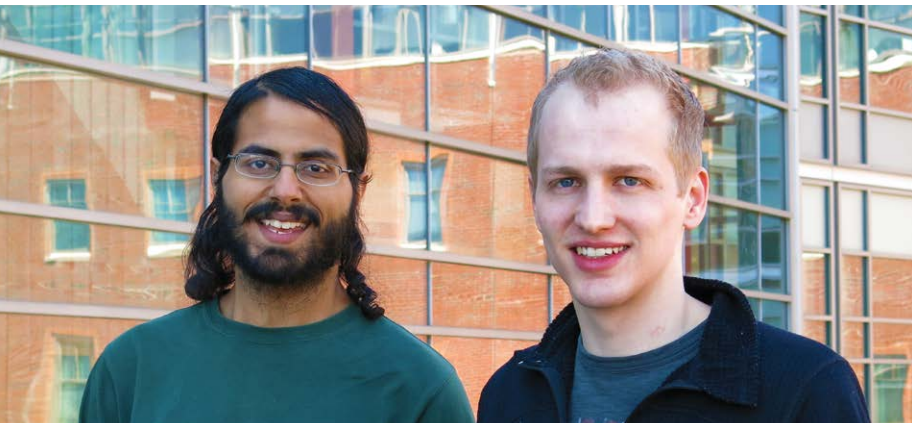
He said he felt they chose well, because the interviews for the 2014 workshop are underway, and "When you see the number of applicants jump from 140 to 240 in one year, you know that the students are coming back and doing a good job of spreading the word to other students."

Taylor has personal knowledge of the entrepreneurial experience. He received his master's in computer science at Illinois in 2003. After acquiring an MBA in 2005 and working for Honeywell for a period of time, Taylor came back to Illinois in 2007 to oversee sales and operations in a successful startup venture with his former advisor, Professor Yuanyuan Zhou. In addition to his work at TEC, Taylor is an Entrepreneur-in-Residence with Enterprise Works.

Now his mission, and the mission of TEC, is to help create the next generation of great entrepreneurs. Taylor concluded, "These students represent the kind of passionate students we have the pleasure of working with and mentoring on a daily basis."

Watch the two-minute video on what students learned on this year's trip at: <http://bit.ly/1blonq6>





Jones and Sodhi Receive Illinois Innovation Prize

BY LEANNE LUCAS

*CS graduate students
Rajinder Sodhi and
Brett Jones*

This past spring, CS graduate students Brett Jones (BS CS '08, MS '10) and Rajinder Sodhi (BS CS '08, MS '10) each received an inaugural Illinois Innovation Prize, along with a \$10,000 gift provided by Engineering at Illinois. These prizes were given as part of the Lemelson-Illinois student prize competition. Administered by the Technology Entrepreneur Center (TEC) at Illinois, the Lemelson-Illinois Student Prize competition recognizes innovative students who work to solve grand challenges and strive to be entrepreneurial.

TEC director Andrew Singer said, "The talent this year was so incredible that the judges simply found it impossible not to celebrate and award more than one. As a result, with the help and support of the College of Engineering, we created and awarded two of the first Illinois Innovation Prizes to two outstanding individuals."

Jones was recognized for his work on IllumiRoom, which he did as part of an internship at Microsoft. According to a Microsoft website, "IllumiRoom is a proof-of-concept system from Microsoft Research. It augments the area surrounding a television screen with projected visualizations to enhance the traditional living room entertainment experience."

The system combines a Kinect for Windows camera and a projector to "blur the lines between on-screen content and the environment we live in." The system will essentially expand the game experience beyond the screen to the entire room.

Jones is particularly excited about potential applications for this process in theater or museum settings. "We're trying to do things that no one has done before and then say, 'What could artists do with this?'" he said.

IllumiRoom was featured during Samsung's keynote at the 2013 Consumer Electronics Show and has received extensive press coverage, including articles in the *USA Today* and *BBC News*, as well as a host of technology and gaming publications.

Sodhi's project, AIREAL, is a new haptic technology that was developed as part of an internship with Disney Research Pittsburgh. AIREAL is a small box, made largely of 3D printed parts, that fires tiny vortices of air (think smoke rings without the smoke) at users. Coupled with an image on a projection or television screen, users can feel the touch of an object. For instance, when a soccer goalie in a video game moves his hands to deflect a shot on-screen, AIREAL pairs the ball with a blast of air.

A demonstration video produced by Disney shows how the technology could go well beyond connecting a single AIREAL box to a video game. Precisely choreographed units, working in unison, could fire back and forth to let the user feel a butterfly settling on his skin and moving up his arm. A virtual trip to the beach might include the feeling of seagulls swooping and diving near the user's head.

Sodhi said the experience could be further enhanced by tapping into various dimensions

of the vortex. "The strength of the vortices, the speed at which they're shot and their waveforms can all be played with to create a variety of invisible objects and phantom sensations."

Like Jones, Sodhi's work has garnered significant attention. It has been featured on numerous technology web sites, and mentioned in features on FOX News and the BBC.

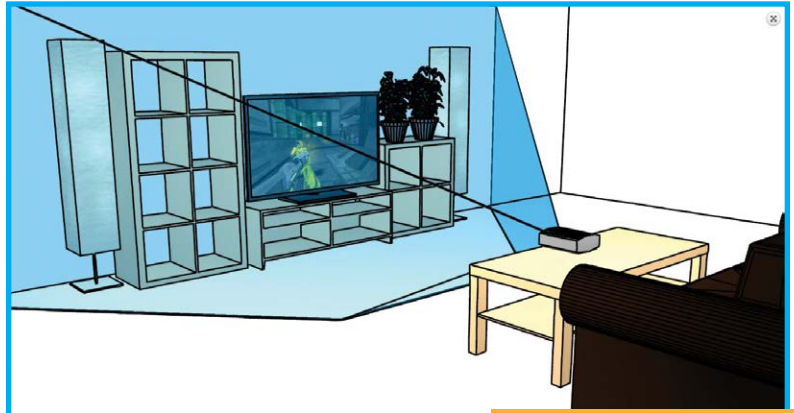
In addition to receiving the Illinois Innovation Prize, both Jones and Sodhi were Siebel Scholars in 2010. Siebel Scholars receive a monetary award and are recognized as some of the most talented students at the world's leading graduate schools of business, computer science, and bioengineering. In 2011, both were named Qualcomm Innovation Fellows. Qualcomm Fellowships provide financial support for projects that demonstrate significant futuristic, innovative ideas.

Both students are co-advised by CS Professors David Forsyth and Brian Bailey. Of the two faculty members, Jones said, "They've been invaluable to us," and Sodhi agreed. "They've both been very supportive and open with what we've wanted to explore."

"These two young men are driven, they're excited, they're interested in what they're doing, and they're good at it," said Forsyth. "Largely, what we do is sit on the sidelines, give advice, and keep out of the way."

"Our department is very good at handling people who do things their own way," he continued.

"These students have had amazingly successful, unconventional careers. We have rich resources available to them. When they need something, there is always someone here to talk to. This is a place where people like these young men can flourish."



IllumiRoom

Jones' project, IllumiRoom, combines a Kinect for Windows camera and a projector to "blur the lines between on-screen content and the environment we live in."

See a demo of IllumiRoom at <http://bit.ly/1dyL0P1>



AIREAL

Sodhi's project, AIREAL, is a new haptic technology that was developed as part of an internship with Disney Research Pittsburg.

Watch AIREAL in action at <http://bit.ly/17Xxo1R>



PURE Helps Undergraduates Gain Research Experience

BY JAMAL COLLIER, ECE ILLINOIS

Young and enthusiastic college students can get involved in a program called Promoting Undergraduate Research in Engineering (PURE). This program allows students to get hands-on research experience as undergraduates.

PURE bridges the gap between the faculty, upperclassmen, and graduate students working on research and the underclassmen who want to get started. CS senior Craig Roper, president of PURE, said the group goes out and finds graduate students willing to take on a sophomore or freshman as a mentee.

Zach Widder, a sophomore in electrical engineering, got involved in the program this past fall. Although he was nervous meeting his mentor at first, the process ended up working out well.

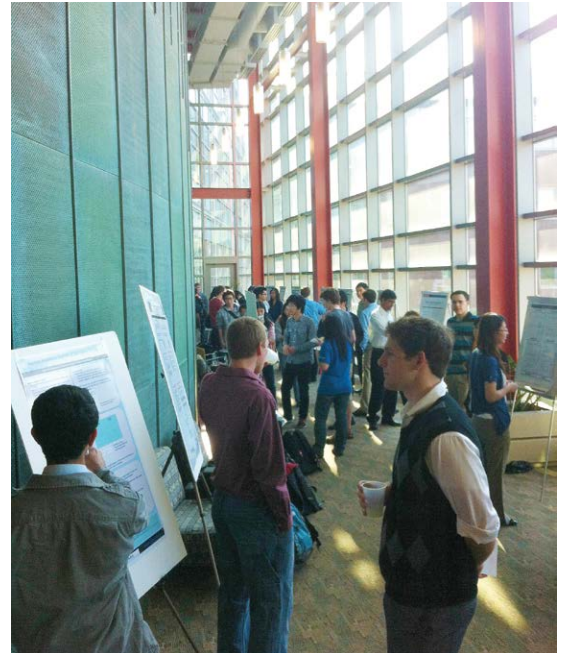
“He wound up being a very cool person that I definitely use a resource for not just research, but for help with some of my classwork and advice for things like career fairs,” Widder said.

PURE is also responsible for informing the mentees of exactly what they’re getting into before they take on a project like this one.

“One of the biggest things we’re doing is making sure all the mentees know what they’re getting into, know what the time commitment is going to be like, what the work is going to be like,” Roper said. “Because of that, the last couple semesters we’ve had very positive reviews, and the mentors say all their students have been great.”

After the mentees are selected, they fill out a survey to gauge their interest and to find out what classes they’ve taken. Mentees also choose their top two projects, and mentors take on anywhere from one to four students a semester.

PURE started out in the ECE Department, but has since branched out to include the CS Department.



The group held a symposium in December to show off some of the research and other things they’ve accomplished. Roper worked in conjunction with the ECE and CS Departments to provide food and refreshments.

“It was kind of cool to tell people about what I had been doing for a few months,” said Widder of the symposium. He is working on the North American Thermosphere-Ionosphere Network for his project. “My part in the project has been analyzing a vast data set and trying to find a temperature threshold between when the sky is cloudy and when it is clear.”

For the past two years, PURE has received funding from Rockwell Collins.

For more information about PURE, visit <http://bit.ly/HRJDRm>



Relyzer Paper Chosen for the IEEE Micro's Top Picks 2013

A paper co-authored by Siva Hari (PhD CS '13) and Professor Sarita Adve was chosen for the IEEE Micro's Top Picks 2013. The paper, "Relyzer: Exploiting Application-Level Fault Equivalence to Analyze Application Resiliency to Transient Faults," was published in the Proceedings of Architectural Support for Programming Languages and Operating Systems (ASPLOS), March 2012. The annual Top Picks issue recognizes the top papers from the previous year's computer architecture conferences based on novelty and potential for long-term impact. This year, 78 papers were in contention, and only 11 received this honor.

This work presented Relyzer, a comprehensive application resiliency analyzer that evaluates a program's vulnerability to in-field hardware errors. With technology scaling, the increasingly smaller devices become susceptible to hardware errors, some of which may silently corrupt application outputs producing Silent Data Corruptions or SDCs. This presents a serious reliability threat to computer systems. Relyzer is the first approach to address this challenge by providing the capability to identify virtually all hard-to-detect errors that produce SDCs. Relyzer achieves this goal by obtaining a detailed application resiliency profile by systematically analyzing all application fault-sites



Professor Sarita Adve

without performing time-consuming fault injections on all of them. It employs a set of novel fault pruning techniques to lower the evaluation time by 2-6 orders of magnitude for the studied applications.

Relyzer's ability to list virtually all SDC-vulnerable program locations can transform the area of designing application-centric resiliency solutions to meet any

resiliency and performance targets. Relyzer also opens new avenues of research in designing inherently error-resilient programming models. As a first step, the authors employed Relyzer, identified SDC-hot program locations, and developed low cost program-level error monitors to eliminate SDCs, a much lower-cost alternative to a state-of-the-art solution. This novel application-centric resiliency solution, enabled by Relyzer, allows programmers and system designers to tune resiliency at low cost.



Siva Hari (PhD CS '13)

At Illinois, Hari, the paper's lead author, won several awards for his work, including the W. J. Poppelbaum Memorial Award given by the Department of Computer Science and the 2012

Margarida Jacome GSRC Best Poster Award. In addition, he was one of only 200 young researchers in computer science and mathematics invited to participate in the inaugural Heidelberg Laureate Forum in September 2013. This unique week-long forum brought together young scientists, like Hari, to interact with laureates of some of the most prestigious awards within science, including 27 Turing Award winners. After graduating in August, Hari joined NVIDIA, where he is a research scientist.

The Relyzer paper was also co-authored by Helia Naeimi and Pradeep Ramachandran (MS CS '07, PhD '11), employees of the Intel Corporation.



CS @ ILLINOIS Welcomes Four

Andreas
Kloeckner



Assistant Professor Andreas Kloeckner brings new expertise in high-performance scientific computing and the numerical solution of partial differential equations to the department. He received his PhD from Brown University in 2010. "Most of my work has involved computer simulations of complicated wave problems," he said. "These occur in many engineering applications, ranging from fluid flow and weather prediction to simulations of electromagnetic interference."

Kloeckner has released numerous open-source software packages, some of which have grown to have large and thriving user bases. His software interests are centered around resolving the perceived conflict between high-performance and human friendly, abstract code, using run-time code generation and code transformation techniques.

As one may expect, a lot of Kloeckner's work involves a heavy dose of mathematics. As he explains, lines become blurred in the area of his research interest: "There's always a math component, there's always a CS component, and there's always an application component," he said. "And I think that's fantastic."

Kloeckner particularly looks forward to working in an outstanding engineering college at Illinois. "Engineering is very strong here," he said, "and there are many possible applications of my work, each providing a potential opportunity for having an impact on numerical and engineering practice."

Tao
Xie



Associate Professor Tao Xie received his PhD in computer science from the University of Washington in Seattle in 2005. He then joined North Carolina State University as a faculty member, where he taught and performed research until joining Illinois this year.

Xie is an expert in software engineering. In particular, he focuses on software testing, debugging, program analysis, software analytics, and software security. "The ultimate goal of my research is to improve software dependability," said Xie.

At Illinois, Xie will lead his research group to continue work on tool automation for improving software dependability. He received an NSF CAREER award in 2009 to study cooperative testing and analysis: how to enable tools and users to cooperate for better accomplishing the ultimate goal. This involved bringing human factors into the process of tool automation. "We want to engage software engineers, the typical users of our software engineering tools, to work with the tools to produce better results, such as better effectiveness of software testing and analysis," said Xie.

Another research focus would be on extending the scope of dependability attributes targeted by his research. Xie would like to explore attributes such as performance and security along with their impact on dependability, in particular through collaborations with other engineering faculty members from diverse fields.

Xie was the recipient of an IBM Jazz Innovation Award in 2008; IBM Faculty Awards in 2008, 2009, and 2010; and a Microsoft Research Software Engineering Innovation Foundation Award in 2011.

New Faculty

BY TOM MOONE

Ranjitha
Kumar



Ranjitha Kumar will receive her PhD from Stanford University in January 2014. Her expertise lies at the intersection of computer science and design. As Kumar explains it, though tools such as Photoshop and InDesign can provide blank pages for designers to fill in, they don't do much to support creativity. Kumar's dissertation research focused on applying data mining and knowledge discovery techniques to help designers draw on prior work, introducing what Kumar calls "design mining."

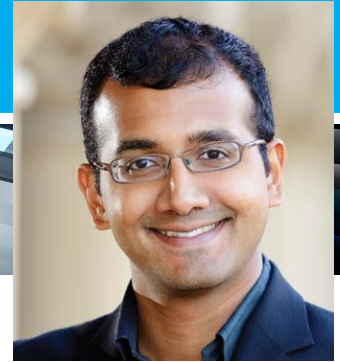
During her PhD, she studied the way designers use software to identify opportunities to amplify human creativity with technology. Her work bridges aspects of machine learning, data mining, human-computer interaction, cognitive science, theory, and system building.

Kumar is taking a year between completing her PhD at Stanford and joining the department to found a new company, Apropose, Inc. "At Apropose we're building applications to support Web designers by making it easier for them to leverage existing work in new projects. Google wants to understand all the information on the Web; we want to understand all the design," she said.

Kumar has received best paper awards or nominations at both of the premiere HCI conferences (CHI and UIST), and has been recognized by the machine learning community through invited papers at IJCAI and ICML. She received the Stanford University School of Engineering Fellowship in 2007 and the Google PhD Fellowship in Design Development in 2011.

Kumar and Parameswaran will join CS @ ILLINOIS in fall 2014.

Aditya
Parameswaran



Aditya Parameswaran also comes to Illinois after completing a PhD at Stanford University. He is an expert in data management and data mining.

His dissertation investigated the difficulties that arise when using crowdsourcing for big data problems. "Given that you want to get data processed using humans, how do you do it in the most efficient and effective way possible?" Parameswaran said. "How do you reduce cost? How do you ensure low latency? How do you extract the highest possible accuracy from humans? That was the focus of my thesis research."

Prior to crowdsourcing, Parameswaran published extensively in the fields of information extraction and recommendation systems. A common theme of his work is the use of rigorous algorithmic techniques for solving practical data management problems.

Prior to starting at Illinois, Parameswaran is spending a year in Cambridge, splitting his time between MIT and Microsoft Research New England. While at Cambridge, as part of his foray into interactive data analytics, he is exploring a new direction: information visualization.

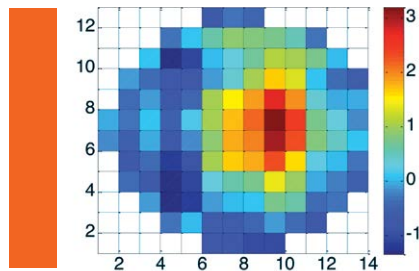
Parameswaran received best paper recognitions at the premier database and data mining conferences – ACM KDD 2012 and VLDB 2010. In 2010 he received a Yahoo! Key Scientific Challenges Award. He received a Terry Groschwitz School of Engineering Fellowship from Stanford University in 2007.

Rutenbar Receives Donald O. Pederson Best Paper Award

Professor and Department Head Rob A. Rutenbar was selected as a recipient of the 2013 Donald O. Pederson Best Paper Award. This annual award is given to the most important research article published during the preceding two calendar years in *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*. Rutenbar was a co-author of “Virtual Probe: A Statistical Framework for Low-Cost Silicon Characterization of Nanoscale Integrated Circuits,” which appeared in the journal’s December 2011 issue.

“IEEE Transactions on CAD is the most elite journal in this area,” said Rutenbar, an Abel Bliss Professor in Engineering at Illinois. “It’s basically the biggest best paper award in the CAD business.”

Map of manufacturing variation for one key performance parameter for an industrial silicon wafer; each square is one manufactured chip. (Courtesy Wangyang Zhang, Carnegie Mellon University.)



The research presented in the article began when Rutenbar read about work on compressive sensing, which was a breakthrough in mathematics. “It gave the ability to re-create a scene from a remarkably small number of observations based on a few assumptions about the mathematical regularity of what you are looking at,” said Rutenbar.

Rutenbar discussed this work with his colleague Xin Li, one of the co-authors of the paper, and how they might use compressive sensing techniques in chip design—in particular for measurements on a wafer’s surface. Such measurements on the surface, called probes, are an important part of the manufacturing process. Even though every chip on a wafer is supposed



to be exactly the same, the physics of nanometer-scale manufacturing means that there is significant variation over the surface of the wafer. “You need to be able to measure stuff to be able to predict what is and is not working on the wafer,” said Rutenbar.

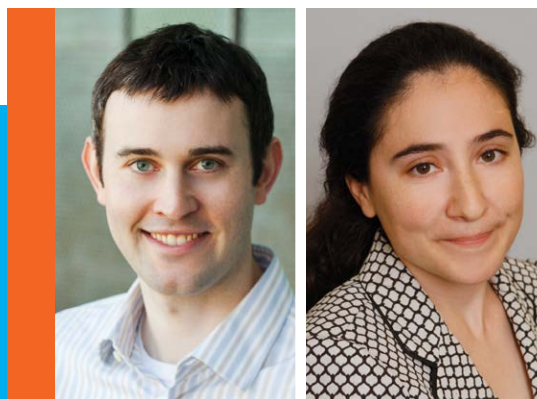
However, probing the surface of the wafer is not only time-consuming but also hugely expensive. Rutenbar and his colleagues came up with what they called a “virtual probe.” Rutenbar explained, “You put a small number of physical probes down, and then using reconstructive mathematics, you can predict results at other locations that you did not physically probe.”

The process already has implications for industry. Several of Rutenbar’s co-authors were from IBM, which provided proprietary industrial data for use in the research. “Our friends from IBM are excited by the opportunities presented by this technology,” said Rutenbar. “We’re looking forward to see what different kinds of applications this is going to enable.”

Rutenbar has actually won the IEEE Pederson Best Paper award two out of the last three years, a feat he notes is “unprecedented.” A Fellow of the ACM and the IEEE, Rutenbar has won several other awards for his work in the chip world. He received the Semiconductor Research Corporation Aristotle Award in 2001, in acknowledgement of the impact of his students on the US semiconductor industry. He also won the IEEE Circuits and Systems Industrial Pioneer Award in 2007, acknowledging the impact of his first startup company, Neolinear, which was acquired by Cadence (NASDAQ: CDNS) in 2004.

Hoiem and Lazebnik Receive Sloan Research Fellowships

BY COLIN ROBERTSON



Professors Derek Hoiem and Svetlana Lazebnik were among 126 early career scientists and researchers from 50 colleges and universities who were selected to receive 2013 Sloan Research Fellowships from the Alfred P. Sloan Foundation. These two-year, \$50,000 fellowships recognize researchers for distinguished performance and their unique potential to make substantial scientific contributions.

Both professors work in computer vision, an area where researchers explore methods to acquire, process, analyze, and understand images. "Derek and Svetlana are pioneering incredible new methods and technologies in computer vision that are laying foundations for the future of the field," said Rob A. Rutenbar, Head of the Department of Computer Science. "We are extremely proud that their work has been honored with this prestigious award."

Hoiem is working on general visual scene understanding—interpreting images in terms of real-world space, surfaces, objects, and relationships. Rather than breaking vision into a set of narrowly defined tasks and tackling them as independent pattern matching or image processing problems, Hoiem seeks to build widely-applicable frameworks that can infer general properties from images and describe the unfamiliar in familiar terms.

He recently co-wrote a book, *Representations and Techniques for 3D Object Recognition and Scene Interpretation*, which organizes and makes accessible recent advances in the field. Hoiem's other awards include a Best Paper Award at CVPR 2006, an Honorable Mention for the 2008 ACM Doctoral Dissertation Award, and a 2011 NSF CAREER Award. Before joining the faculty in 2009, Hoiem

was a postdoctoral fellow at the Beckman Institute for Advanced Science and Technology. He earned a doctorate from Carnegie Mellon University in 2007.

Lazebnik seeks to create a new generation of recognition systems that handle the large-scale, constantly evolving, heterogeneous photo and video collections that are now found online. Her research is aimed at discovering the collective structure of these collections to create compact and scalable representations for accessing their content. Her work has yielded advances in several areas, from fast techniques for fundamental operations such as similarity search; to efficient methods for organizing photo collections based on perceptual and geometric constraints; to higher-level systems capable of interpreting images in terms of their constituent objects, parts and materials.

She is also the recipient of a 2008 NSF CAREER Award, a 2009 Microsoft Faculty Fellowship, a 2011 DARPA Computer Science Study Group Award. Lazebnik earned a doctoral degree from the University of Illinois in 2006. After several years as Assistant Professor at the University of North Carolina, she joined the Illinois faculty in 2012.

Hoiem and Lazebnik join previous Sloan Research Fellowship recipients in the Department of Computer Science: Professors Karrie Karahalios (2010), ChengXiang Zhai (2008), Jeff Erickson (1999), Sarita Adve (1998), and Adjunct Professor Yuanyuan Zhou (2007). Fellow Illinois researcher Taylor Hughes, a professor of physics, was also a recipient of a 2013 fellowship.

Professors Derek Hoiem and Svetlana Lazebnik

Marc Snir Wins IEEE Award for Excellence in Scalable Computing



Marc Snir, Michael Faiman and Saburo Muroga Professor in the Department of Computer Science and director of the Mathematics and Computer Science Division at Argonne National Laboratory, has been named this year's winner of the IEEE Award for Excellence in Scalable Computing.

The award is presented for significant and sustained contributions to the scalable computing community through the IEEE Technical Committee on Scalable Computing. It acknowledges the recipient's outstanding record of high-quality and high-impact research.

"I am honored to receive the 2013 Award for Excellence in Scalable Computing," said Snir. "Research in scalable computing is now more exciting than ever. I have been closely involved with such research through the gigaflop, teraflop and petaflop eras; with my colleagues, I hope to be part of the team that will usher us into the exaflop era."

Snir pioneered the design and development of systems software for large-scale parallel computing systems, including the NYU Ultracomputer, the IBM Scalable Parallel system, and the IBM Blue Gene/L. His contributions included answering fundamental questions about how such innovative systems should be programmed and devising novel interconnect topologies.

Equally impressive was Snir's breakthrough work (with D. Shasha) on efficient and correct execution of parallel programs that share memory. The "Shasha and Snir algorithm" provided the basis for compiler optimizations of explicitly parallel, shared-memory codes.

Snir also was a major participant in the standards committee that designed MPI-1 and MPI-2, the standard communication interface for large-scale parallel computers. He was the lead author of the heavily cited MPI-1 reference book and was co-author of the MPI-2 reference book. He also was the main developer of many of the features that made MPI successful: communicators, datatypes, thread support, and one-sided communication; and he continues to play a major role in the MPI-3 forum efforts.

As head of the Computer Science Department from 2001 to 2007, Snir expanded the department into new areas such as human-computer interaction and computational linguistics. He also led the creation of the Illinois Informatics Institute, catalyzing the university community to apply high-performance computing to the biosciences, social sciences, and humanities. Moreover, he led the successful establishment of the Universal Parallel Computing Research Center at Illinois and was co-director of the center until 2011. Currently, Snir serves as co-director of the Joint Laboratory for Petascale Computing at Illinois, a collaborative project with the University of Illinois and INRIA (the French National Institute for Research in Computer Science and Control).

In 2011, Snir joined Argonne National Laboratory as head of the Mathematics and Computer Science Division. He currently is spearheading efforts in data-driven science, an effort that seeks to develop tools for managing and analyzing the large amounts of data generated by collaborative scientific and engineering projects.

Gropp Named to HPCWire's "People to Watch"



Read HPCWire's story:
<http://bit.ly/19EsTmT>



HPCWire has named William D. Gropp, the Thomas M. Siebel Chair in Computer Science and Director of the Parallel Computing Institute, one of its People to Watch in 2013. According to the publication, the annual list is comprised of "the best and brightest minds of HPC whose hard work, dedication and contributions" are predicted "to reach beyond the spectrum of high performance computing and will influence the direction that technology will lead us in 2013 and beyond."

“ it’s pretty apparent why he’s the point person for setting the 2013 conference back on track. ”

"As this year's reigning General Chair for SC13, Gropp-watching is on the rise," writes HPCWire in announcing Gropp's selection. "Upon closer examination, it's pretty apparent why he's the point person for setting the 2013 conference back on track." Supercomputing 2013, to be held in Denver later this year, is the premier conference in high performance computing, with nearly 10,000 attendees annually.

Gropp, who is the chief applications architect for the Blue Waters petascale supercomputer, is also the Deputy Director for Research for the Institute of Advanced Computing Applications and Technologies and a researcher in the Coordinated Science Laboratory. His research interests are focused on developing parallel computing standards that can be efficiently and widely implemented; developing tools to understand and improve the performance and correctness of parallel programs; and establishing innovative methods for parallelism that will match radical changes in computer architecture.

Notably, Gropp played a major role in creating the MPI, the standard interprocessor communication interface for large-scale parallel computers. He is also co-author of MPICH, one of the most influential MPI implementations to date, and co-wrote two books on MPI: *Using MPI* and *Using MPI2*. In addition, he co-authored the Portable Extensible Toolkit for Scientific Computation (PETSc), one of the leading packages for scientific computing on highly parallel computers.

Gropp is a member of the National Academy of Engineering, a fellow of the ACM and IEEE, has received the IEEE Computer Society Sidney Fernbach Award, the IEEE TCSC Medal for Excellence in Scalable Computing, has received two R&D 100 awards, and was named the inaugural HPC Community Leader by insideHPC.com.

This is the second year in a row that an Illinois computer science professor has been named an HPCWire "Person to Watch." Last year, Marc Snir, the Michael Faiman and Saburo Muroga Professor in Computer Science, was honored.

Rutenbar Teaches First Illinois CS MOOC



This past spring, CS Department Head Rob A. Rutenbar taught a massive open online course (MOOC) on “VLSI CAD: Logic to Layout” through Coursera. It was one of the first University of Illinois MOOCs taught, and the very first MOOC from CS.

Rutenbar, an Abel Bliss Professor of Engineering, co-chaired the committee that explored MOOCs at the University of Illinois, and his work led to the Illinois-Coursera partnership in 2012. As part of that process, he recruited colleagues to create the first Illinois MOOCs for the Coursera platform, and he volunteered to create one of the courses.

The MOOC focused on software algorithms for modern VLSI (Very Large Scale Integration) chip design. Though based on a course that he had taught many times, it still required significant changes. With over 17,000 registrants for this MOOC, “you can’t grade anything by hand,” said Rutenbar. “You can’t do a three page detailed math derivation, and check it in some qualitative manner for partial credit. Everything’s got to be computer based.”

Rutenbar’s on-campus course is roughly 20 lectures, comprising about 1000 detailed technical slides. The MOOC version ended up as 69 video segments, with an average length of 15 minutes, each focusing on one key technical topic. Like many doing MOOCs, Rutenbar found that he could actually move through his material at a faster pace. “You don’t have to repeat yourself to make sure they get it. They can always replay the parts they didn’t understand the first time.”

The course also had a very sophisticated software ecosystem, developed by a team of PhD students,

Nick Chen, Chen-Hsuan (Adonis) Lin, and Zigang (Ivan) Xiao. “My TAs were just amazing,” says Rutenbar. “I’ve never had a more sophisticated unit-test system for student-software.”

Students were given industrial design data for several large-scale chip problems. They submitted solutions to the Coursera cloud, and the grading system analyzed their results, scored them, and even offered insights about where they had problems.

Though the course was intended for graduate students, the range of students was quite broad. Many were professionals who were trying to hone skills or develop new ones. A few were teenagers who just wanted to learn more about computer science.

Overall, said Rutenbar, the experience was “An amazing amount of work, but a remarkably satisfying experience. I got a tremendous amount of positive feedback.”

Rutenbar believes that the MOOC format shows great promise for providing educational content, but exactly how the technology will be used is still uncertain. “The analogy I use is that this is like the Internet in 1993,” he said. “This is really cool. This is going to be something. What’s this going to be? None of us knows. But this technology is substantial and impactful.”

For more information on Illinois MOOCs, visit www.coursera.org/illinois



Zilles Receives Student Senate Teaching Excellence Award

BY TOM MOONE



Professor Craig Zilles was one of five recipients of the 2013 Illinois Student Senate Teaching Excellence Award. More than 615 nominations were received for this year's recognition.

"I had no idea I was even nominated," said Zilles, an associate department head in the Department of Computer Science. "I value teaching, and to be recognized this way is exciting."

Zilles felt particularly gratified that he received this award this year because this past fall the two-course computer architecture sequence was converted to a single 4-unit course, offered with the temporary number CS 398: Computer Architecture.

As Zilles explained, "whenever you do something new, and especially with that many students, to have students appreciate the effort we put into that—I was excited and a little surprised to receive this award at this time."

For Zilles, the fact that his computer architecture class is a required course makes his job a little bit more difficult. He feels he has to work to make students interested in the subject matter. "They weren't born with the desire to take my class," he said. "If they understand what's cool about this stuff I'm telling them, they're more likely to go and learn it."



By all accounts, his efforts were appreciated. CS sophomore Purajit Malalur, who took CS 398 with Zilles in fall 2012, said, "I think he designed the class really well, and it was really taught well. He's very active in class, and he keeps students involved by asking them questions."

Zilles tries to keep students engaged through a contest called SPIMbot. Students write programs that control a virtual robot to accomplish some task in a virtual world, and at the end of the semester, their programs compete in a double elimination tournament, akin to the March Madness college basketball tournament. The contest enables students to take code they've written for class assignments, extend and improve the code, and develop a simple artificial intelligence to play the game. "It's kind of a neat thing, and it gives a fun context for some of the things they've learned," said Zilles. "Students really enjoy this."

This is not the first time that Zilles has been recognized for excellence in teaching. The College of Engineering awarded him the Rose Award for Teaching Excellence in 2007 and the Everitt Teaching Award in 2008. He also received the Mac Van Valkenburg Early Career Teaching Award from the IEEE Education Society in 2010.

The Illinois Student Senate awards five Teaching Excellence Awards every year. CS Professor Lawrence Angrave was one of last year's winners.



Zhai Named a Donald Biggar Willett Scholar

Professor ChengXiang Zhai was named a Donald Biggar Willett Scholar. This recognition is given to faculty members in the College of Engineering who are relatively early on in their career yet are excelling in their academic concentrations. Zhai was one of eight college faculty members to receive this recognition this year.

Zhai's research looks at developing intelligent information systems that can help people better manage and exploit large amounts of information and data. He aims to create next-generation search engines that go beyond the basic search mechanism to support data mining.

"With the dramatic growth of online information, we are overwhelmed with huge amounts of information and

have an urgent need for powerful software tools to help manage and make use of it," Zhai said.

Zhai joined the Illinois faculty in 2002 after receiving his PhD from Carnegie Mellon. He received a Presidential Early Career Award for Scientists and Engineers (PECASE) in 2004, a Sloan Research Fellowship Award in 2008, and an NSF CAREER Award in 2004. He was named an ACM Distinguished Scientist in 2009. In 2012 he received an HP Labs Innovation Research Program Award. He received the C. W. Gear Outstanding Junior Faculty Award from the CS @ ILLINOIS in 2007, and the Rose Award for Teaching Excellence from the College of Engineering in 2010.



Sam Kamin Retires BY TOM MOONE

Professor Sam Kamin retired after 33 years at the University of Illinois. During his time at the university he taught and conducted research in the areas of programming languages, high-performance computing, and educational technology.

Kamin served as director of undergraduate programs from 1999 to 2007. In that capacity, he led a reevaluation of the computer science curriculum. At time, CS 242: Programming Studio was designed and launched. In this course, students give and receive critiques on programs they and their classmates have written. He also became interested in educational technology. His project Students Learn in Collaborative

Environments (SLICE) includes a framework for programming tablets for use in the classroom.

Kamin's research focused on programming languages; he has also published in the areas of formal methods, high-performance computing, and educational technology. He is the author of *Programming Languages: An Interpreter-Based Approach*, a textbook on programming languages, and is co-author of introductory books on Mathematica, C ++, and Java.

Following his retirement from the department, Kamin moved to New York City to be closer to family.



Microsoft CEO Steve Ballmer and Department Head Rob A. Rutenbar

Rutenbar Interviews Microsoft CEO Steve Ballmer in Chicago

Department Head Rob A. Rutenbar traveled to 1871, an incubation center for digital startups in Chicago's Merchandise Mart, to take part in an event featuring Microsoft's CEO Steve Ballmer. The event brought together Chicago Mayor Rahm Emmanuel and 250 entrepreneurs and venture capitalists to hear from Ballmer.

Rutenbar engaged Ballmer in a brief question and answer session during the visit. They covered such topics as difficulties Microsoft overcame during its early startup days, how Chicago could help foster startups, and how the growing need for mobility will affect Microsoft and its products in the coming years.

Ballmer said that Chicago has many attributes needed for a healthy startup environment, including strong universities, a good presence of venture capital companies, and a good quality of life. Of course, Ballmer also expressed his belief that Microsoft's products could aid startups in getting their companies off the ground and flourishing.

"I was delighted to be asked by our friends at Chicago's 1871 to help moderate Steve Ballmer's visit," said Rutenbar. "This event was part of our ongoing efforts to strengthen the partnership between the City of Chicago and the University of Illinois at Urbana-Champaign—to bolster Chicago as a hub for innovation by retaining top technical talent in the State."

An Illinois-Intel Partnership Leads to Prototype for Debugging Innovations

In a major collaboration, Professors Josep Torrellas and Sam King, together with Intel researchers unveiled a hardware prototype for recording and deterministically replaying parallel programs at the International Symposium on Computer Architecture (ISCA) in June 2013. This system enables the ability to re-execute a program exactly in the same way, and identify where a bug occurred or a security intrusion started. This prototype is called QuickRec, and is composed of an FPGA implementation of an Intel multicore with full support from the Linux operating system.

Torrellas said, "As you are running your program, when you detect a bug, you can use QuickRec to go back and trace the bug—how it came in. If you see a security intrusion, you also go back and see how it arose. QuickRec allows you to go back and see exactly how it got there."

QuickRec could point toward the next level of innovation in performance monitoring and debugging support for processors. A key element of QuickRec is that it does not adversely impact processing speed. "It is just a hardware device that you install to monitor the machine," said King. "It doesn't slow the machine down."

Professors Josep Torrellas and Sam King



Faculty Time in Industry Brings Benefit to Department

BY TOM MOONE



*Professors Darko Marinov
and Indy Gupta*

Engagement with industry comes standard at CS @ ILLINOIS. Faculty members form research collaborations, establish relationships to help when their students are ready to enter the job market, and, of course, there's also constant and widespread consulting.

But sometimes companies need a deeper, more concentrated effort than what consulting can provide. Professors Darko Marinov and Indy Gupta recently embedded with two top technology companies, helping to address the companies' needs and gaining greater insight into what industry is looking for from future CS graduates.

Marinov worked at Groupon in Chicago from January through June of this year. While there, he helped improve regression testing, which helps prevent bugs from reappearing in software. Groupon was trying to find a way to run these tests more quickly. "In software development, you can end up with a large number of tests," said Marinov. "Then you have the problem that those tests take a lot of time to run."

Gupta spent nearly a year with Google, from August 2011 through July 2012. A nondisclosure agreement prevents him from divulging much, but he worked with the company's cluster management group.

Both found the work in the industry setting a good change from the rigors of academia. "I loved how it was different from academia," said Marinov.

"For me, the best part of the experience was being able to contribute new designs for, and write code for, production-quality systems which have real, immediate users," said Gupta. "One thing I got in industry were these large chunks of time, where you can focus on only one problem, and you can code for eight hours straight."

Noting that an extended stay in a company is beneficial, Gupta said, "By the time you are getting into the hang of things, and feel you can contribute, that's six months. One month or two months are fine. But if you have the luxury of taking a year and spending time there, I think that is best."

From 'Deep Research' to 'Block and Tackle'

BY BILL BELL, COLLEGE OF ENGINEERING

Faculty members strive to stay aware of where the computing industry is headed, and embedding with industry is a great way to do that. "It has definitely changed the kinds of problems I work on," said Gupta. According to Marinov, his experience exposed him to "completely new problems that I don't think I would have thought of if I hadn't seen them there." These problems will drive some of his future research projects.

In addition, each has made some changes to the classes that they teach. Marinov mentioned when he teaches his software engineering course, he can now bring personal industrial experiences to bear on some of the topics covered in the course. "I can say something specific based on what I have seen there," he said.

Gupta also believes that industry experience gives him some additional tools for his teaching arsenal for individual courses. But he noted that the experience has also influenced how he relates to his research group. "I realized was that my interactions with my [PhD] students previously were mostly strictly professional," he said. "One of the things that I really enjoyed with my Google experience was the nonprofessional, playful interactions that may start out non-technical but could lead to some very technical results."

Faculty members strive to stay aware of where the computing industry is headed and embedding with industry is a great way to do that.

Chicago's mayor, Rahm Emanuel, was in town meeting with Illinois' tech talent and trying to convince them to land in Chicago when they graduate. Security, news cameras, panel discussions, a career fair of the sort that's so big the fire marshal considers shutting it down. It was the kind of day that a university loves. And dreads. It was a great, harried, exciting, long event.

Amid all of that, CS Department Head Rob A. Rutenbar and Jeff Holden (BS CS '91, MS '92), a senior vice president at Groupon, were able to catch a few minutes together. They swapped notes on how Groupon could become more involved with CS @ ILLINOIS and then dove back into their days.

A few months later, Professor Darko Marinov was weighing how to spend his sabbatical and considering embedding with a variety of companies. Rutenbar introduced Marinov to Holden, who in turn introduced Marinov to Jeff. Ayars is vice president of Engineering for Experience Optimization at Groupon.

Within a few months, Marinov was up and running at Groupon for a six-month embed with a team working on a back-end automated testing suite. "Darko jumped in and was a peer," Ayars said. "Academics have a very different perspective on how to approach problems, a focus on the deep research issues."

Marinov's work at Groupon, however, was "very block and tackle," according to Ayars. The team Marinov was part of made concrete improvements that shaved 50 percent off the time it took to run the testing suite.

Still, a professor's eye has its place, even on the most applied of problems. "Darko came at every interaction with an attitude that was: 'I'm going to learn from you, but I'm going to ask a lot of questions,'" Ayars said. "It's like a teacher's trick—those kinds of questions are the ones that help you find holes in your own thinking."

GEMS Camp Introduces Middle School Girls to Computer Science

BY TOM MOONE

For two weeks during the summer, the halls of the Siebel Center were filled with some atypical sounds—the laughter of 11- and 12-year-old girls. These middle school girls were here to participate in the 2013 Girls Engaged in Math and Science (GEMS) Camp.

Led by CS Professor Cinda Heeren and CS sophomore Bri Chapman, the week-long GEMS camp introduced 49 girls from the Urbana-Champaign area to computer science. The camp was given twice: June 17–21 and June 24–28.

The GEMS curriculum focused on the ways in which computing impacts the food industry. A visit to the market at the Union (featuring produce from the student sustainability farm) and guest speakers representing perspectives on the local food industry were held.

Students developed food-themed apps for Google Nexus tablets using App Inventor, a drag and drop instructional program for Android systems. “App Inventor is an entry level programming system, but it is powerful,” said Chapman. “We were excited to see what the girls came up with.”

Chapman has a long history with the camp. Seven years ago she was a GEMS participant herself, and this marks her third year as a camp leader.

Heeren and Chapman both felt that the camp went extremely well, and that the participants had a great time learning. Chapman said, “Those girls flew through almost everything I had planned for the week in the first day, and it just happened because they were happy and excited and enthusiastic.”

One of the key aspects of the camp was fostering collaboration. Students worked in teams, and the instructors made each group member responsible for every other member. They all worked together to keep everyone up to speed.

In addition to the instructional parts of the program, the focus was having fun and enjoying the learning environment. There were several spontaneous dancing events that helped lighten the mood and keep the participants motivated.

The approach worked. On Thursday of each week, the participants were given a survey comparing themselves before GEMS and after



Professor Cinda Heeren

their experiences. "I would have been happy to see two surveys out of the 25 that said, 'I want to be a CS major,'" said Heeren. "But it was unanimous. Each and every girl said something like: I didn't know how to use apps; now I want to make apps. I didn't know computer science could change the world. Every single one of them had some remarkable contrast that showed that they got it."

They have already begun planning for next year: how they'll take what they've learned and bring it to a new batch of middle school girls.

A project like this could not have happened with a great deal of assistance. Chapman and Heeren were assisted by Marrissa Hellsen, Hanan Jaber, and Jenny Ye. "And my gratitude to the CS Department has to underlie everything," said Heeren. The assistance from the department went from providing space and funding for the camp to locating plates and tableware when food deliveries did not include them. "Everyone was very gracious to us," said Chapman.

GEMS was founded in 1994 and was originally run through the National Center for Supercomputing Applications. Heeren explained, "GEMS had been hosted by NCSA for 20 years. When its founder, Edee Wizecki, retired, we were fortunate to have the opportunity to adopt a robust and well-known program. We are proud to continue Edee's vision of a free day-camp, providing the local community with high-quality summer activities."

This year, GEMS received a National Center for Women and Information Technology's Aspire IT award for middle school outreach.

Learn more about GEMS at gems.cs.illinois.edu



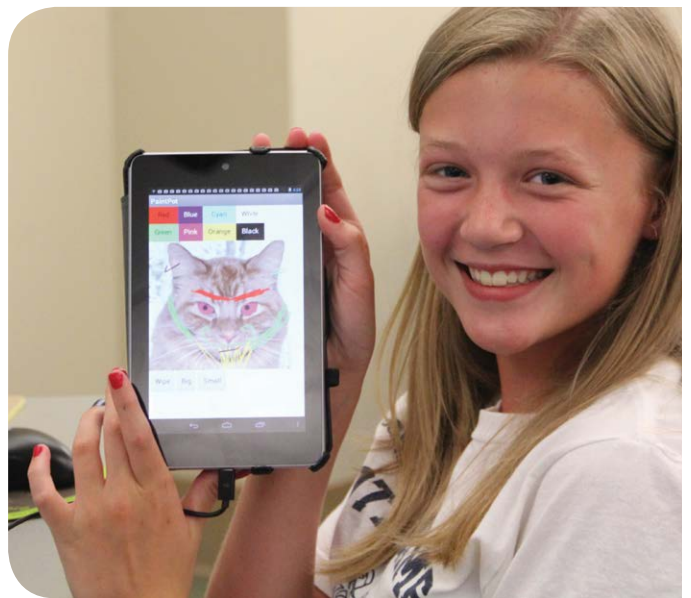
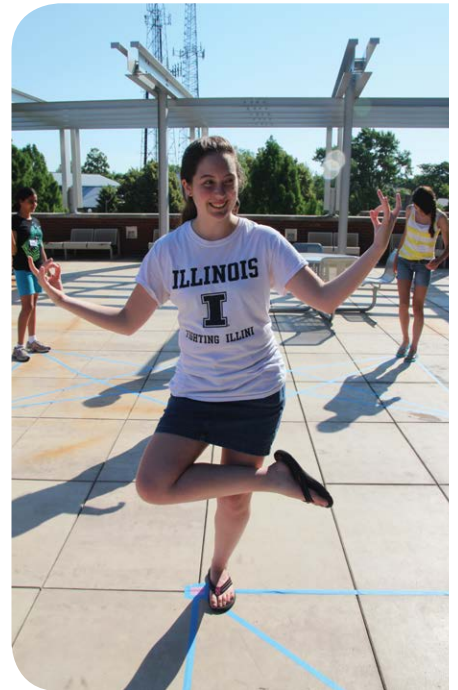
Seeking Major Sponsors

CS @ ILLINOIS is currently seeking major sponsors (corporate or individual) to expand the camp to reach more girls. If you would like to help, please contact Director of Advancement Michelle Wellens at mwellens@illinois.edu for more information.

RIGHT:
CS sophomore
and GEMS leader
Bri Chapman
takes part in a
graphing exercise.

MIDDLE:
GEMS student
shows off her mobile
app developed
during camp.

BOTTOM:
The GEMS Camp
included a visit to the
farmer's market held
outside the Illini Union.



Celebration of Excellence Student and Faculty Awards



CS @ ILLINOIS honored the students and faculty who have received important distinctions over the past academic year. We extend congratulations to these individuals whose hard work is a credit to themselves and a source of pride for the department.



C. W. Gear Outstanding Graduate Student Award

KYLE FOX is studying computational topology under the guidance of Professor Jeff Erickson. He is a previous recipient of the Department of Energy Office of Science Graduate Fellowship and has interned at Google Research. He plans to graduate in December 2013 and begin a postdoc at Brown University.

UNDERGRADUATE AWARDS & SCHOLARSHIPS

**C.W. GEAR OUTSTANDING
UNDERGRADUATE AWARD:**
Aadhar Jain and Mateusz Wala

**CROWE HORWATH LLP OUTSTANDING
COMPUTER SCIENCE STUDENT**
Daniel Garcia-Carrillo and John Kaczor

DANIEL L. SLOTNICK SCHOLARSHIP
Briana Chapman

DUNCAN H. LAWRIE STUDENT LEADERSHIP AWARD
Corey Fry

**DUNN SYSTEMS SCHOLARSHIP IN
MEMORY OF ARTHUR R. DUNN**
Kurtis Houdek and Eric Mills

FRANZ HOHN AND J.P. NASH SCHOLARSHIP
Adam Miller

ICCP JAMES N. SNYDER MEMORIAL AWARD
Suharsh Sivakumar

**JAMES N. SNYDER AWARD FOR
SCHOLASTIC ACHIEVEMENT**
Vijay Bhattiprolu and Robert Pieta

JEFFREY P. BLAHUT MEMORIAL SCHOLARSHIP
Tej Chajed

JOHN R. PASTA AWARD
Sili Hui and Yerzhan Suleimenov

**MICHAEL S. HUGHES AWARD FOR
SOFTWARE ENGINEERING**
Joel Dodge, Robert Heidkamp, Caleb Johnson,
Onur Karaman, Matthew Omori, Zachary
Wand, Thomas Zhang, and Terence Zhao

GRADUATE AWARDS

C.L. AND JANE W.S. LIU AWARD
Kai-Wei Chang

**C.W. GEAR OUTSTANDING
GRADUATE STUDENT AWARD**
Kyle Fox

DIFFENBAUGH GRADUATE FELLOWSHIP
Maxie Schmidt

FENG CHEN MEMORIAL AWARD
Abdullah Al-Nayeem, Kyungmin Bae,
Mingcheng Chen, Siva Kumar Hari,
Ahmed Khurshid, Estaban Meneses,
Parya Moinzadeh, Osman Sarood, Reza
Shiftefar, and Wenxuan Zhou

**GRADUATE STUDENT OUTSTANDING
AMBASSADOR AWARD**
Yonatan Bisk

**GRADUATE STUDENT OUTSTANDING
SERVICE AWARD**
Charles Blatti

ILLINOIS INNOVATION PRIZE
Brett Jones and Rajinder Sodhi

KENICHI MIURA AWARD
Hormozd Gahvari

OUTSTANDING TEACHING ASSISTANT, SPRING 2012
Riccardo Crepaldi, Navin Fogla, Manoj Krishnan,
Choonghwan Lee, and Yun Young Lee

OUTSTANDING TEACHING ASSISTANT, FALL 2012
Donald Ellison, Lu An Tang, Jon
Tedesco, John Wieting, and Xiao Yu

QUALCOMM INNOVATION FELLOWSHIP
Rakesh Komuravelli

SYMANTEC RESEARCH LABS
GRADUATE FELLOWSHIP
Chi-Yao Hong

W.J. POPPELBAUM MEMORIAL AWARD
Xuehai Qian

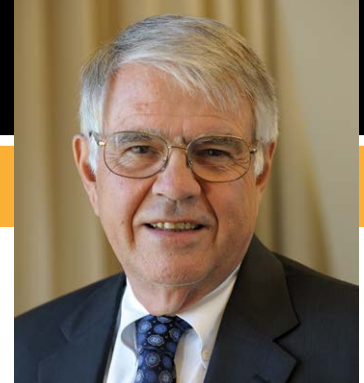
YAHOO! OUTSTANDING TEACHING
ASSISTANT AWARD
Ryan Cunningham

ILLINOIS STUDENT SENATE TEACHING
EXCELLENCE AWARD
Craig Zilles

SIMONS RESEARCH FELLOWSHIP
Alexandra Kolla

SLOAN RESEARCH FELLOWSHIP
Derek Hoiem and Svetlana Lazebnik

TAU BETA PI DANIEL C. DRUCKER
EMINENT FACULTY AWARD
William Gropp



FONTAINE K. RICHARDSON

(PhD CS '68), a pioneer in designing CAD/CAM systems, helped establish three awards in the Department of Computer Science to honor his advisor and former Department Head C. W. Gear: the C. W. Gear Outstanding Undergraduate Award, the C. W. Gear Outstanding Graduate Student Award, and the C. W. Gear Outstanding Junior Faculty Award.

FACULTY AWARDS

2013 HPCWIRE PERSON TO WATCH
William Gropp

AAAS MEMBER AT LARGE
William Gropp

ACL FELLOW
Dan Roth

ACM FELLOW
Klara Nahrstedt

ACM SOFTWARE SYSTEM AWARD
Vikram Adve

C.W. GEAR OUTSTANDING JUNIOR FACULTY AWARD
Matthew Caesar

CAS BECKMAN FELLOW
Matthew Caesar

DEAN'S AWARD FOR EXCELLENCE IN RESEARCH
Svetlana Lazebnik and Saurabh Sinha

DONALD BIGGAR WILLETT FACULTY SCHOLAR
ChengXiang Zhai

HP LABS INNOVATION RESEARCH PROGRAM AWARD
Laxmikant Kalé and ChengXiang Zhai

IEEE COMPUTER SIDNEY FERNBACH AWARD
Laxmikant Kalé

IEEE TCRTS OUTSTANDING TECHNICAL
ACHIEVEMENT AND LEADERSHIP AWARD
Tarek Abdelzaher

IEEE TCSC MEDAL FOR EXCELLENCE
IN SCALABLE COMPUTING
Marc Snir

IIE AWARD FOR TECHNICAL INNOVATION
IN INDUSTRIAL ENGINEERING
Sheldon Jacobson

COMPUTER SCIENCE RESEARCH SYMPOSIUM

OUTSTANDING DEMO PRESENTATION
Robert Pieta

OUTSTANDING UNDERGRADUATE
POSTER PRESENTATION
Daniel Gierl

OUTSTANDING UNDERGRADUATE
RESEARCH PROJECT
Aadhar Jain, Sean Massung, and Mateusz Wala

OUTSTANDING GRADUATE POSTER PRESENTATION
John Tedesco

OUTSTANDING GRADUATE RESEARCH PROJECT
Chi-Yao Hong, Ankit Singla, and Jason Saupe

Support CS Students and Faculty

Many of these awards and scholarships are made possible by generous donations from alumni and corporate partners. If you would like to establish a scholarship or sponsor an award, please contact Director of Advancement Michelle Wellens at mwellens@illinois.edu for more information.



\$100 Million Grainger Engineering Breakthroughs Initiative to Boost CS @ ILLINOIS

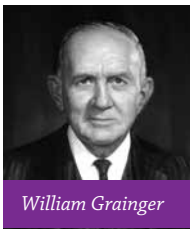
BY BILL BELL, COLLEGE OF ENGINEERING



Information has always been vital to science, engineering, and society—to the way we live for better and for worse. “People have always recognized the importance of understanding information. Always. They’ve wanted to analyze what’s available to them, make better sense of it, and turn it into actionable decisions that will translate into something valuable,” said Department Head Rob A. Rutenbar.

“Napoleon Bonaparte said ‘War is 90 percent information’ about 200 years ago, and he wasn’t telling people anything they didn’t already know,” he said.

So it’s little surprise that CS @ ILLINOIS has long had a strong footprint in data science. Professors Jiawei Han and Dan Roth have both spent decades advancing the field. And our CS



William Grainger

alums have launched numerous startups whose novel take on the uses of data has disrupted entire industries: companies such as Netscape, YouTube, PayPal, match.com, and Siebel Systems.

“Today, the world’s decided we’re calling it ‘Big Data.’ Tomorrow, we’ll be calling it something else. Whatever name we give it, CS @ ILLINOIS has been one of the academic institutions defining the field,” Rutenbar said.

That contribution to the field is about to get a lot larger. In early 2013, the College of Engineering announced the \$100 million Grainger Engineering Breakthroughs Initiative. About \$20 million of that will support more than a dozen new senior faculty in one of the initiative’s two key thrusts: Big Data.

“Those new faculty members aren’t all going to be in computer science,” explained CS

Professor Roy Campbell, who is chairing the committee guiding the Grainger Initiative’s Big Data hiring. “That’s exactly as it should be. We need people in electrical and computer engineering attacking the hardware issues. People in industrial and enterprise systems engineering considering those perspectives. Civil and environmental engineers using Big Data to keep structures and systems safe and efficient.”

But CS will be crucial to the initiative and will see substantial growth because of it.

The Grainger investment in Big Data leverages two essential elements that make Illinois a top computer science program—and a top engineering college—according to Campbell. First, “Illinois has done this before. In high-performance computing, the National Center for Supercomputing Applications at Illinois really invented something new. They set the standard for working with ‘big science’ and ‘big

How Big is Big Data?

A study by Gartner, a technology research and consulting company provides some examples:

30 BILLION
pieces of content are
added to Facebook
per month.

Zynga processes
1 PETABYTE
of content for its
players every day.

Users create
more than
180 MILLION
tweets per day.



engineering’ researchers to develop ‘big iron’ supercomputer solutions to a range of grand challenge problems. Illinois can do the same for Big Data.”

Campbell continued, “Second, Big Data is inherently and completely multidisciplinary. That open, accessible approach to our work is a fundamental part of Illinois’ culture, and it will pay off here.”

Professor Dan Roth agrees: “Computer science is no longer an area that only looks inward. There is a huge change in the field and a focus on developing technologies that have societal impact. At Illinois, because we are so diverse and know how to collaborate, we have a significant opportunity for leading the data science revolution.”

Learn more
about GEBI at
[graingerinitiative.
engineering.
illinois.edu](http://graingerinitiative.engineering.illinois.edu)



More than
2 BILLION
videos are watched
on YouTube in a day.

Big Data As An Engineering Discipline

CS Professor Roy Campbell was recently invited to share his thoughts on Big Data for the Illinois College of Engineering’s Board of Visitors—a group of accomplished alumni and leaders in industry and government. Here’s some of what he said:

“We are entering a new era of scientific discovery and technology development centered on Big Data. This step forward requires that we reimagine Big Data as an engineering discipline. Big Data is not a set of projects that happen to use similar techniques or algorithms but a new approach that impacts all researchers and disciplines. We’ve reached the point where discovery simply won’t happen effectively or fast enough without the ability to analyze, draw insights from, and make good decisions based on massive stores of data.

“If we don’t integrate Big Data’s amazing promise into our world, genomics and medicine won’t make the most of our ability to generate a person’s genome. Public policy will remain more an art than a science, even with much more detailed information about all the issues that inform it. Our ability to embed our world with the tiniest and highest-fidelity sensors won’t make our streams cleaner, our bodies healthier, or our society safer.”

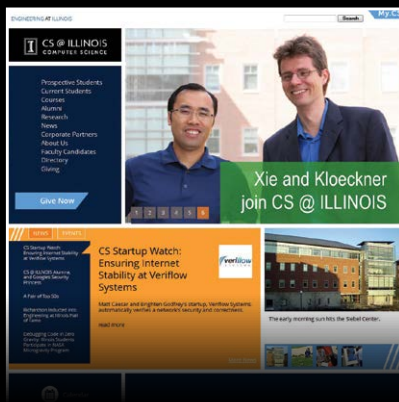
The Grainger Engineering Breakthroughs Initiative

Engineering at Illinois combines the smartest minds in a culture that embraces collaboration and approachability. The Grainger Engineering Breakthroughs Initiative, built on a \$100 million gift, is perfectly suited to that distinctive culture. It will initially focus on bioengineering and Big Data, fields that grow from collaborative and multidisciplinary roots.

The Grainger Initiative covers all the key elements that make Illinois a truly elite program—faculty chairs and named professorships, undergraduate scholarships, world-class facilities, and support for research.

Upgrading the CS @ ILLINOIS

The Department of Computer Science's network of alumni, faculty, students, and industry partners is extensive and incredibly powerful. We are striving to develop and improve our ability to **STAY CONNECTED WITH YOU**, and to **CONNECT YOU WITH EACH OTHER**.



THE CS @ ILLINOIS WEBSITE

was recently redesigned with the understanding that it is often our first impression for prospective students and faculty, and provides deep resources for our campus community and our alumni. Visit us at www.cs.illinois.edu.



Social Network



THE E-NEWS delivers the department's top stories right to your inbox. And it links you to upcoming networking events, both in your area and on campus. Subscribe at: go.cs.illinois.edu/enews.



What you have in your hands is **click! MAGAZINE**—mailed twice yearly to showcase the breadth, depth and impact of our accomplished alumni, faculty, staff, and students.



We invite you to **JOIN THE CONVERSATION**—frequently!—and share your thoughts with us on LinkedIn, Twitter, and Facebook.



WE WELCOME YOUR FEEDBACK to keep our connections to you strong. To share your suggestions, latest career news, or to update your contact information, please email us at click@cs.illinois.edu or scan the QR code to use our online form.





Blue Waters Supercomputer is Officially Launched



An event marking the official launching of the Blue Waters supercomputer was held at the National Center for Supercomputing Applications (NCSA) on Thursday, March 28.

Because Blue Waters is among the most powerful supercomputers in the world, and is the most powerful supercomputer on any university campus, it enables scientists to carry out research that would be otherwise impossible. The supercomputer, which was built from Cray hardware, operates at a sustained performance of more than 1 quadrillion calculations per second (10^{15} floating point operations, or 1 petaflop) and is capable of peak performance of 11.61 quadrillion calculations per second (10+ petaflops).

During a launch celebration at NCSA, Illinois Governor Pat Quinn read a proclamation declaring March 28 as “Blue Waters Supercomputer Day”, and encouraging “everyone in the Land of Lincoln to recognize the important role that innovation and technological progress play in the future of our state.”



Other speakers during the celebration—including University President Robert Easter, Chancellor Phyllis Wise, and US Rep. Dan Lipinski, who serves on the House Committee for Science, Space and Technology—also emphasized the role that Blue Waters and the University of Illinois play in science and engineering discoveries.



Cora Marrett, acting director of the National Science Foundation, the federal agency that provided the deployment and operational funding for Blue Waters, emphasized the supercomputer’s potential to fuel discovery and innovation and to benefit society. For example, scientists hope to learn more about how viruses infect the body’s cells and to improve predictions of tornadoes and hurricanes, among other diverse projects.

Because Blue Waters is among the most powerful supercomputers in the world..., it enables scientists to carry out research that would be otherwise impossible.

the #lastword

CS @ ILLINOIS is using its social networks to enhance its connection to students, faculty and alumni. Are YOU Linked, Liking, and Following? Here are some excerpts of notable posts:



@IllinoisCS



CS alumna Linda Mills (MS CS '73) made Fortune's list of the "50 Most Powerful Women in Business"

Distinguished Alumni r n the Siebel house today&tomorrow!

TONIGHT! Andreessen Horowitz presents startup BELLY. 7:30pm 2405 Siebel RSVP 2 enter 2 win JawboneUp

Union Pacific Talk-15 min! 2405 Siebel 10 things u shld know about Eclipse.

CS alumnus Jeff Holden (BS CS '91, MCS '92) featured as one of Crain's Tech 50

5Enova HACK tonite! Food+prizes=FUN!!! 6pm 2405 Siebel. Did we say prizes? MacBook Air, iPad, \$100 AmEx GC, Woot!

Jump Trading Tech Talk tonight! 5:30pm 2405 Siebel Center. Food too (really yummy food). Topic=Non-Uniform Memory Access

Posted by: @acmreflections We have over 1000 registered attendees! If you haven't registered yet, now is not too late!

Posted by: @TwitterU We're back at UIUC to talk about Killing the Fail Whale! Come to 2405 Siebel Center @ 6pm. Free food and shirts!

University of Illinois
Computer Science



Have you seen the latest Fortune Magazine 40 Under 40? The 2013 list includes two #ILLINOIS alums! Co-Founder and CEO of Yelp, Jeremy Stoppelman is #16 while co-founder of Glow, Max Levchin is #28. This is Levchin's third appearance on the list, he was previously recognized as a founder of PayPal and Slide.

CS alumna Ping Fu (MS CS '90) will be a featured speaker at Chicago Ideas Week.

CS alumnus Vilas Dhar (BS CS '04) was profiled in Forbes for his socially conscious law firm and the launch of his nonprofit incubator, the Next Mile Project.

CS undergrad Matthew Dierker was featured in the Sugar Land Sun, talking about internships at Facebook and Google.

CS @ ILLINOIS



Check out the interview with CS alumna and LinkedIn employee Kamilah Taylor, who is featured on Being Geek Chic.

D.C. alumni event to feature CS faculty member Sheldon Jacobson.

All Engineering at Illinois alumni are invited to join the college for the Engineering Homecoming Celebration!

Department of Computer Science
College of Engineering, College of Liberal Arts & Sciences
University of Illinois at Urbana-Champaign
Thomas M. Siebel Center for Computer Science
201 N. Goodwin Avenue
Urbana, IL 61801

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Keep in touch!

We want to stay connected with our alumni and friends. To share your latest career news and update your contact information, please email us at: click@cs.illinois.edu or scan the QR code to use our online form.

BELOW: CS inspires middle school girls to dance... see p. 40.



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