CS @ ILLINOIS

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MAGAZINE 2016, VOLUME I

HARNESSING THE POWER OF THE

DATA REVOLUTION

Department of Computer Science

It is a capital mistake
to theorize before one has data.

Sherlock Holmes

CS @ ILLINOIS

Department of Computer Science
College of Engineering, College of Liberal Arts & Sciences
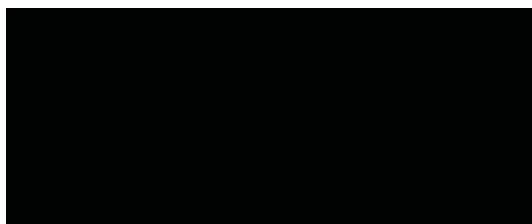University of Illinois at Urbana-Champaign

DO THE IMPOSSIBLE EVERY DAY.

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MAGAZINE 2016, VOLUME I

> **"** Regular alumni engagement with the department is key to keeping this place great. **"**

CS @ ILLINOIS alumni and faculty have long had "big game" in data science—gathering, analyzing, and using big data for society's benefit. So it's no surprise that Illinois has been tapped by the National Science Foundation to lead the Midwest Data Hub, which will bring together data scientists and domain experts to collaborate on topics ranging from smart cities and network science, to digital agriculture and advanced manufacturing, to healthcare and biomedical research.

Outreach continues to be a huge priority for us as we broaden the diversity of our student population and give industry a growing pipeline of talented young women and men to take our discipline to the next level. We are implementing programs that connect with young people and their families at key points along their educational journey. From Hour of Code—open to the community for families with children of all ages—to Gems Computer Science Camp for middle and high school girls, to ChicTech ("sheek-tek") visits to local school administrators, educators, and student classrooms, we are committed to doing our part to inspire and educate more young people about the fascinating and fun applications of computer science.

It was a pleasure to have several CS @ ILLINOIS luminaries recently return to campus. It was wonderful to see David Kuck be inducted into the College of Engineering Hall of Fame, and to have Turing Award Winner Andrew Yao (PhD CS '75) give a keynote lecture on quantum computing. We paid tribute to another class of fourteen distinguished alumni at our fifth annual CS @ ILLINOIS Awards ceremony. It's also a tremendous honor to announce that C. W. "Bill" Gear has included CS @ ILLINOIS in his estate plan. It's fitting that Bill's legacy of contributions to the field and his service to this department will be an inspiration to all CS faculty, staff, and students now and forever.

Regular alumni engagement with the department is key to keeping this place great. If you would like to be more connected to our current students, faculty, and programs, but need more information on the options, please take a look at the next page—a new regular feature on how you can get involved and make a difference.

Hope to see you soon.

Rob A. Rutenbar | Head and Abel Bliss Professor

GET INVOLVED!

Build the Talent Pipeline

Got a big heart for outreach—especially for young women and underrepresented minorities? So does CS @ ILLINOIS. We have developed programming throughout the year to engage and inspire more young people to explore the fun and diverse applications of computer science.

- **Sail (April): a day of student-run workshops targeted for high school students**

- **NCWIT Aspirations Awards (April): recognizes high school girls for their interest in computer science**

- **Gems Computer Science Camp for Girls (June & July): 6 weeks of day camp for middle and high school girls**

- **ChicTech Retreat (November)—an overnight retreat for high school girls**

- **Hour of Code (December)—open labs for coding fun for the whole family**

All of these outreach activities are funded by the CS Department, alumni donations, and corporate partners. To get involved, email Cynthia "CJ" Coleman at ccoleman@illinois.edu

Stay Active with CS Student Groups

Were you part of a student group and do you want to stay connected? The CS-Affiliated Student Groups are strong and as active as ever. They are eager for alumni to stay involved, and welcome corporate partners to participate in events.

- **HackIllinois (February)**

- **ACM Showcase (April)**

- **WCS Alumni & Student Banquets (April & October)**

- **ACM Reflections | Projections Conference (Fall)**

Join in the CS @ ILLINOIS Alumni Network

Help us keep the CS @ ILLINOIS Alumni Network strong—attend a regional CS networking event in some of our high alumni population cities across the country. We have plans to be in Chicago, New York, and San Francisco on regular cycles. Keep an eye out for e-invites. Make sure your contact info is up to date with us!

Engineer in Residence

Schedule a custom Engineer in Residence experience where you can meet with faculty, give a presentation, attend or speak in a class, meet with student groups, and tour the newest areas of campus. Email Michelle Wellens at mwellens@illinois.edu to schedule your campus visit today.

Visit Campus for CS Awards and Homecoming

CS @ ILLINOIS joins forces with our student groups, including ACM and WCS, to jointly host the WCS Alumni & Student Banquet and the CS @ ILLINOIS Distinguished Alumni Awards. Held in conjunction with Homecoming, this is hands down the best time to visit campus to deeply engage with CS faculty, students, and fellow alumni. Enjoy panels, networking events, campus tours, tailgating, and football. (October 27–29, 2016)

Poloney and Fisher Visit CS @ ILLINOIS as Engineers in Residence

BY TOM MOONE

The CS @ ILLINOIS Engineer in Residence (EIR) program allows successful alumni to interact closely with CS students.

During their visits, EIRs engage with students, helping to inform their computer science education and discuss what leads to successful careers. This typically includes a presentation, informal meetings with students and faculty, and office hours for students interested in more personalized advice.

This fall, CS hosted two EIRs: Joel Poloney (attended 2004-2007), one of the original developers of FarmVille, and Scott Fisher (MS CS '76), a program manager at Ecolab.

Poloney spoke with students during a visit to campus on October 22. In 2006, Poloney and three Illinois classmates—Sizhao "Zao" Yang, Amitt Mahajan, and Luke Rajlich—started MyMiniLife Inc. to develop MyMiniLife, a virtual world and social networking application. In 2009, the team joined Zynga, as they were developing FarmVille, whichbecame the most popular game on Facebook.

Poloney and Mahajan later left to found Red Hot Labs in 2011. In February 2015, Google purchased the mobile marketing company. Poloney is now a tech lead on Google's AdMob app, which continues this work.

"There's a magical art to pivoting your company—there's really no right or wrong way to do this," Poloney said. "Try not to get too emotionally invested in one particular product. Think about the greater vision."

Scott Fisher visited the department on November 3, and his presentation gave the students (who had not been born when he completed his degree) a taste of the history of the department and of the computer science field.

Among the items he shared with students were computer punch cards like those he used to complete his graduate thesis, and a sample of magnetic core memory from one of the first computers he worked on. "This was about 45 years ago, and it was 4KB, and it was state of the art," he said.

After a career at such companies as Digital Equipment Corporation, Philips NV, Remmele Engineering, and Minco, Fisher is now at Ecolab, where he manages one of the company's IT groups.

Fisher ended his talk with some career advice gained from his experiences with a variety of industries: "When you go out to find a job, find out the chemistry of the department," he said. "What's it like. Is it a group that gets along quite well and helps each other and wants to win?"

With these presentation, as with all EIR events, students benefit significantly from the real-world experiences that our alumni have to share. If you are interested in participating in the EIR Program, please email Michelle Wellens at **mwellens@illinois.edu**.

Scott Fisher (MS CS '76) and Joel Poloney (attended 2004-2007) shared career insights through the Engineer in Residence Program

Wang Wins 2015 SIGKDD Dissertation Award

BY LAURA SCHMITT

While data mining technologies are widely used to discover patterns in structured data, such as in databases, there's a treasure trove of information hidden in unstructured data, such as event logs, product reviews, emails, and social media messages. Researchers have tried to uncover semantically rich structures from these sources of unstructured text with mixed results—that is until Chi Wang (PhD CS '14) cracked the code.

According to Wang, his method enables you to analyze what topics a particular person (President Obama, for example) is involved in. "I can analyze news articles that mention Obama and provide a hierarchical view of all the different things like politics, national issues, international issues, or healthcare, for example, that he is involved in," explained Wang. "Within each of these topics, I can further find significant subtopics and topical phrases so we can analyze in different granularity."

Chi Wang (PhD CS '14)

> " This award motivates me to do even better work and make my techniques and methodologies more useful so people recognize the power of data mining. "
>
> Chi Wang

Wang, who worked in CS Professor Jiawei Han's group, developed methods for mining latent entity structures from massive unstructured and interconnected data, and he applied them to a variety of domains such as academic service, event log and news article explorer, and product review analytics.

In August, Wang received the 2015 SIGKDD Dissertation Award—a highly competitive honor in the data mining, machine learning, and data sciences areas—for his breakthrough research that produces quality topics, phrases, and relations with little or no supervision.

"This award motivates me to do even better work and make my techniques and methodologies more useful so people recognize the power of data mining," he said. "It makes me feel that all the hard work at Illinois was worth it and it helped push my career."

Wang's approach was to model the unstructured data as text-rich heterogeneous information networks capable of handling text only (long articles or informal Tweets, for example), network-only (interconnected data), or text plus links. His work laid down a comprehensive mining framework of hierarchical topics surrounding entities, the roles these entities play, and the relations among entities.

Some other functionalities of Wang's method are an ability to analyze the roles of entities in user-desired context, to determine the role in a given topical community, and to determine the relationships among entities.

"My mining approach can have entity structures from unstructured data and linked data, and it can transfer that information into rich, useful knowledge," said Wang, who published a book, *Mining Latent Entity Structures*, with his advisor, Han.

Han is proud of his student. "My students are very creative, and [Wang] has done really great research overall, publishing about 30 papers when he was here," said Han. "He also earned a prestigious Microsoft Research PhD Fellowship—the first and only Illinois CS student to get this."

Wang is currently a researcher at Microsoft Research in Redmond, Washington, where he is developing algorithms to discover knowledge from unstructured data. These algorithms will be incorporated into products that enable enterprise users to manage data in an easy, interactive way.
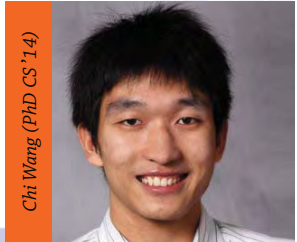
CS @ ILLINOIS RECOGNIZES
OUTSTANDING ALUMNI

On October 23, CS @ ILLINOIS held its fifth annual Alumni Awards Ceremony and Banquet. This annual event gives the department an opportunity to recognize those alumni and faculty whose work has had an impact on the field of computer science and the world at large. At this year's banquet, fourteen individuals were recognized.

DISTINGUISHED ACHIEVEMENT

The CS @ ILLINOIS Distinguished Achievement Award honors computer science graduates who have made professional and technical contributions that bring distinction to themselves, the department, and the university.

Rick Cattell

During his 20+ years at Sun Microsystems, Rick Cattell (BS CS '74) was best known for his contributions to database and server software, including database scalability, enterprise Java, object/relational mapping, object-oriented databases, and database interfaces. Today, Cattell is an independent consultant in database systems; he is an ACM Fellow, holds seven U.S. patents, and has written five books.

Jackson Hu

Jackson Hu (MS CS '76, PhD '78), a distinguished 40-year semiconductor industry veteran, is the chairman and CEO of NeoEnergy Microelectronics. During his career, Hu led the team that developed the industry's first GUI accelerator chip (enabling Microsoft Windows to run more smoothly and quickly), he led the development of a cost-effective and accurate chipset that brought GPS into smartphones, and he was chairman and CEO at UMC, the world's second largest semiconductor foundry.

Pete Koomen

Pete Koomen (MS CS '06) is the co-founder and CTO of Optimizely, which makes an experience optimization platform for websites and mobile apps. Before that, Koomen spent three years as a product manager at Google, where he helped launch and grow Google App Engine. He also co-wrote the book *A/B Testing: The Most Powerful Way to Turn Clicks into Customers*, which focuses on how companies can influence people's behavior when they visit their website.
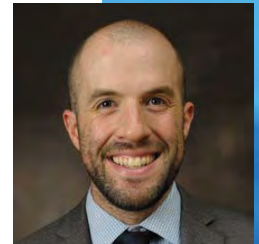
Lynn Reedy

A successful technology executive, Lynn Reedy (BS Math & CS '77) has worked in software and software development her entire career. She is best known for leading the complete redesign of eBay's website—both hardware and software—without disrupting the auction site's operations during a time of rapid growth while she was CTO.
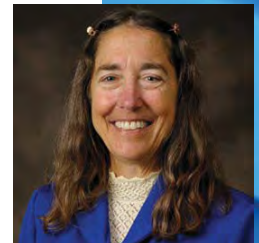
Russel Simmons

Russel Simmons (BS CS '98), the one-time lead software architect at PayPal, helped design the web-based payment system from scratch. In 2004, he co-founded Yelp, the popular social networking site that allows users to write reviews of local businesses, and served as the company CTO until 2010. Today, Simmons is exploring new approaches to education through a video-based foreign language product.
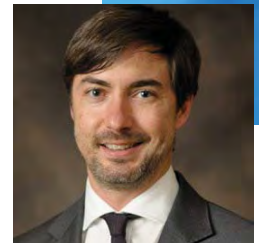
DISTINGUISHED EDUCATORS

The CS @ ILLINOIS Distinguished Educator Award honors computer science alumni or faculty members who have made outstanding contributions to computer science education and research, and recognizes those who excel at motivating computer science students.

Nancy Amato

Nancy Amato (PhD CS '95) is the Unocal Professor of CS and Engineering (CSE) at Texas A&M University, where she has advised 41 PhD and MS graduates. As a researcher, Amato is known for her contributions to the algorithmic foundations of motion planning in robotics and computational biology. She is also known for being a tireless and highly effective leader of programs that engage women and underrepresented minorities in computing research.
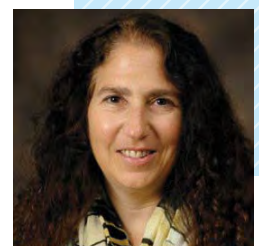
Luis Ceze

Luis Ceze (PhD CS '07) is the Torode Family Career Development Professor of Computer Science & Engineering at the University of Washington. His work has enhanced the performance of multicore processors in notebook and tablet computers, while improving programmability, reliability, and energy efficiency. He has founded two successful companies that advance parallelism.

Apu Kapadia

Apu Kapadia (BS CS '98, MS '01, PhD '05) is an associate professor of Computer Science and Informatics at Indiana University, where he is investigating topics related to security and privacy from a systems and human-factors perspective. He has received an NSF CAREER Award, a 2014 Google Research Award, and 2013 Indiana University Trustees Teaching Award.
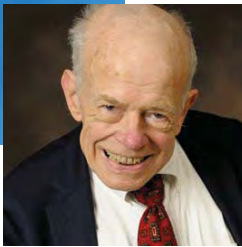
Paul Saylor

During his 34-year Illinois career, CS Professor Emeritus Paul Saylor conducted pioneering work in numerical analysis, solving large-scale scientific problems in areas ranging from geophysics to medical imaging. He also taught numerical analysis classes. Saylor and his wife, Cynthia, were close friends with Illinois alumnus Gene Golub (BS Math '53, MA Stats '54, PhD Math '59, Hon DSc 1991), the late Stanford CS faculty member and pioneer in the numerical analysis field. Golub endowed a CS faculty chair at Illinois in honor of Saylor's kindness, support, and generosity, as well as his dedication to his students and the academic life.

DISTINGUISHED SERVICE

The Distinguished Service Award honors alumni or faculty who have demonstrated an outstanding level of commitment to the department and its students, faculty and alumni through their support and service.

William Dunn

William Dunn (BS CS '86, MS '87) is the president and founder of Dunn Solutions Group, an IT consulting firm focused on business intelligence (data warehousing, big data, and predictive analytics) and custom application development, including mobile applications, portals, and custom web applications.
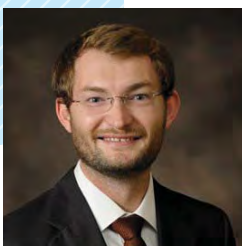
Dave Paola

Dave Paola (BS CS '10) is co-founder and CTO of Bloc, an experiment in online mentorship which has turned into a successful company. Bloc is the world's largest online software development boot camp. Before starting Bloc, Paola was a software engineer at Kontagent/Upsight, a scalable analytics and marketing platform for web and mobile app developers.

C. W. GEAR JUNIOR FACULTY AWARD

Established by alumni, friends, and former students to recognize contributions and services of C. William Gear, head of the department from 1985 to 1990, the C. W. Gear Outstanding Junior Faculty Award recognizes junior faculty for their outstanding research and teaching.

Paris Smaragdis

Assistant Professor Paris Smaragdis's research revolves around making machines that can understand sound the same way people do. He has created new tools for processing and analyzing time series, and his work draws heavily from the fields of machine learning and statistical signal processing. He has received the College of Engineering's Outstanding Advisor Award, is frequently named to the campus list of teachers ranked as excellent by their students, and he is developing multiple new cross-disciplinary courses on machine learning, signal analysis, and media processing.

DAVID J. KUCK OUTSTANDING THESIS AWARDS

These awards were established by alumni, former students, and friends in recognition of Professor Kuck's intellectual and leadership contributions. Each year, two awards are given: one for an outstanding doctoral thesis and one for an outstanding master's thesis.

John Criswell

As a member of Professor Vikram Adve's research group (2003–2014), John Criswell (PhD CS '14) developed a Secure Virtual Architecture for commodity software systems, which was the first to provide strong automatic protection for an OS kernel like Linux or FreeBSD. Today, Criswell is an assistant professor of computer science at the University of Rochester, where his research focuses on computer security and automatic compiler transformations to enforce security policies on commodity software.
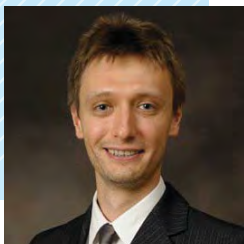
Cosmin Rădoi

A doctoral student in Professor Grigore Rosu's Formal Systems Lab, Cosmin Rădoi (MS CS '13) has developed a very precise static race detector for Java, explored ways to introduce parallelism to JavaScript, and is currently focused on program transformation through rewriting. Rădoi conducted his master's research with Adjunct Assistant Professor Danny Dig. This work received the ACM SIGSOFT Distinguished Paper Award.

Yao Sees Quantum Computing as the Next Great Science

BY LAURA SCHMITT

As part of the CS @ ILLINOIS alumni awards weekend, Andrew Chi-Chih Yao (PhD '75) gave a keynote titled "Quantum Computing: A Great Science in the Making." Yao, a 2000 A.M. Turing Award recipient, spoke to several hundred faculty, alumni, and students defending why quantum computing will become the next great science.

"I think quantum computing is for real," said Yao, describing the technology that exploits the properties of quantum mechanics and that could lead to computers much more powerful than today's supercomputers.

Yao noted that Moore's law will eventually come to an end and that scientists and engineers cannot avoid looking to the quantum effect for improvements in computing speed. "Quantum computing will pay off sooner than many people believe," he said.

Yao, the dean of the Institute for Interdisciplinary Information Sciences at Tsinghua University in China, has been interested in quantum computing since the early 1990s. "If it's feasible, it's going to be done," he said. Already, organizations like Microsoft, NIST, and major universities are investing in the technology.

Watch Dr. Yao's presentation on quantum computing: http://bit.ly/1Pl9bV6

Burbidge Named Chair of Tech City UK

Eileen Burbidge (BS CS '94) was recently named the Chair of Tech City UK. Since its launch in 2010, Tech City UK has been providing support to digital entrepreneurs throughout the United Kingdom. Its focus is on creating the optimum conditions for digital technology businesses to thrive by informing policymakers about the needs of the digital business community, especially in the area of skills, infrastructure, and investment.

Burbidge is a Partner with Passion Capital, an early stage venture capital firm based in London. She is a member of the Prime Minister's Business Advisory group and is also the Tech Ambassador for the Mayor of London. In 2014 she was named one of London's Most Influential People by the *Evening Standard* newspaper, and in 2012 was listed in *Wired Magazine*'s list of the 100 most influential figures in Britain's digital economy.

Eileen Burbidge
Photo courtesy of Tech City UK.

Kuck Inducted in
the Engineering at Illinois
Hall of Fame

BY MIKE KOON, COLLEGE OF ENGINEERING
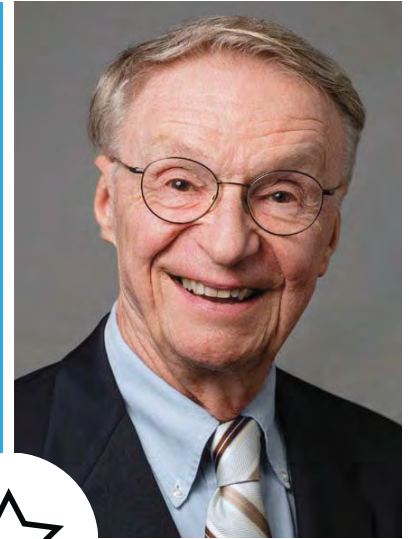
Over the past four decades, Kuck influenced a wide range of areas, including architecture design and evaluation, compiler technology, programming languages, and algorithms.

Retired CS and ECE Professor David J. Kuck was inducted into the Engineering at Illinois Hall of Fame on September 18 "for significant contributions in both research and development through industry to productivity tools in parallel computing."

Kuck is one of the most influential figures in parallel computing, especially in productivity tools for parallel programming. Over the past four decades, he influenced a wide range of areas, including architecture design and evaluation, compiler technology, programming languages, and algorithms. His influence has been both theoretical and practical.

Kuck was a professor of both computer science and electrical and computer engineering at the University of Illinois from 1965 to 1993. At Illinois, he, along with Ahmed Sameh, helped create the Computational Sciences program, which initiated a new and unique research focus that has contributed significantly to Illinois' multidisciplinary excellence. The Center for Supercomputing Research and Development at Illinois, which he created in 1983, was extraordinarily influential in developing parallel computing technology (from hardware to algorithms) in the era of vectorization and symmetric multiprocessing. As founder and director of Kuck and Associates (KAI) and later

as an Intel Fellow, Kuck's work influenced industry. Every compiler in use today incorporates techniques pioneered by Kuck, targeting parallelism in its many forms and managing locality. In this era of multi-core and many-core architectures and petascale supercomputers, this work is now more important than ever, adapting software to use new hardware effectively. As an outgrowth of his compiler work, he initiated efforts that led to the development of OpenMP, the most common solution for incorporating threads into scientific applications.

His R&D career has included contributions to the architecture and software of a number of parallel computer systems, including ILLIAC IV, Burroughs BSP, Alliant FX, and Cedar, as well as the development of the Parafrase compilation software for parallel program restructuring.

Kuck is a Fellow of the IEEE, ACM, and AAAS. He has received a number of awards for computer architecture and software design, including the IEEE Piore Award, the IEEE Computer Society's 2011 Computer Pioneer Award, the ACM-IEEE Eckert-Mauchly and Kennedy Awards. He is a member of the National Academy of Engineering.

HARNESSING THE POWER OF THE

DATA
BY LAURA SCHMITT & COLIN ROBERTSON

REVOLUTION

Every day, Twitter processes 500 million tweets in real time to determine trending topics, Match.com identifies thousands of potential relationships, PayPal's anti-fraud measures sift through $300 million in payments, while medical researchers use genomic data to develop new cancer treatments. The common link? Data science.

Influential media outlets like *Forbes*, *Harvard Business Review*, and *The New York Times* have all touted data science—the process of extracting meaningful and actionable information from massive and varied sets of data ("big data")—as the hot new discipline that is transforming business and society.

The excitement revolves around the promise of new statistical and computational tools capable of extracting knowledge from the Digital Revolution's massive deluge of data, especially since much of the data generated today is unstructured, messy, and possibly untrustworthy.

"Lots of people in lots of areas knew how valuable data was, but they didn't necessarily have the tools to do something with it," said CS Professor **David Forsyth**, an expert in computer vision. "What is wonderful now is our ability to do things we couldn't do."

Unsurprisingly, CS @ ILLINOIS alumni have been helping drive the data science revolution. Advances have included Siebel Systems' customer relations management software and C3 Energy's smart energy platforms (**Tom Siebel**, BA History '75, MBA '83, MS CS '85, Honorary '06), YouTube's enormous online video archive (**Steve Chen**, attended, and **Jawed Karim**, BS CS '04), Yelp's authentic user-generated local reviews (**Russel Simmons**, BS CS '98), PayPal's online payment system (**Max Levchin** BS '97), and Informatica's enterprise data integration and management applications (**Sohaib Abbasi**, BS CS '78, MS '80).

It's estimated that 80-90% of all the data that corporations and other entities deal with is unstructured, meaning that it comes in the form of text and images in email, blogs, event logs, product reviews, social media, news outlets, and dozens of other sources. Researchers at Illinois are developing the theories, algorithms, and tools to transform raw data into useful and understandable information. Here are just a few examples.

Internationally known for his work in big structured data, data mining pioneer **Jiawei Han** is now developing novel techniques for mining information from unstructured data. His approach is to mine latent entity structures from massive unstructured and interconnected data.

His statistics-based algorithms automatically grab meaningful phrases from text and determine if they refer to a person, place, or thing in a scalable way.

One of his phrase-mining algorithms, which works on multiple languages, was a grand prize winner of the 2015 Yelp Dataset Challenge. Three of Han's text mining software packages are being used by the Army Research Lab.

"Essentially, it watches patterns and [word] combinations and learns from them so it can figure things out," said Han, who demonstrated his system on a variety of domains including Yelp restaurant reviews and scientific research publications. Further, Han's method can infer relationships between entities and its runtime is much faster than alternative methods used on large datasets.

In the medical arena, Han and CS Professor **Saurabh Sinha** are part of a $9.3 million NIH-funded collaboration with Mayo Clinic to create a revolutionary analytical tool—Knowledge Engine for Genomics (KnowEnG)—that will allow biomedical researchers to place a gene-based data set in the context of all previously published gene-related data. This broad context for individual data sets will offer new functional insights for the genes being studied.

CS Professor **Dan Roth** is helping ICG Solutions, a real-time analytics company, draw insights on the 2016 presidential debates from tens of thousands of Twitter messages. ICG is employing some of Roth's natural language understanding tools in its LUX streaming analytics platform. These tools identify entities (names of people,

Professor David Forsyth

Professor Jiawei Han

Professor Saurabh Sinha

Professor Dan Roth

MUCH OF THE DATA GENERATED TODAY IS UNSTRUCTURED, MESSY, AND POSSIBLY UNTRUSTWORTHY. RESEARCHERS AT ILLINOIS ARE DEVELOPING THE THEORIES, ALGORITHMS, AND TOOLS TO TURN RAW DATA INTO USEFUL INFORMATION.

Professor Aditya Parameswaran

Professor Derek Hoiem

Professor Svetlana Lazebnik

Professor Tandy Warnow

organizations, location), sentiment analysis (people's feelings about a candidate), and demographic parameters of those sending the Tweets.

Another aspect of Roth's research investigates the trustworthiness of big data. "We not only want to know what people are saying about a topic, but can we believe it?" said Roth. "Algorithmically, you can determine if a source is trustworthy and if the claims are credible or not. We use this same technology for [debate] sentiment analysis."

Roth co-founded NexLP to commercialize his text understanding and analytics tools. The Chicago-based company's core technology is Story Engine, which automatically extracts and organizes facts from vast collections of documents like email messages and helps users understand key themes and connections within the data.

This story-telling aspect is a critical element to data science, said Illinois alumnus **Aditya Singh** (BS CE '01, MS EE '04), a partner with Foundation Capital. "The best data scientists in the world will be story tellers who use technology and domain expertise to provide a compelling so-what and who then can communicate that effectively across all the stakeholders," Singh said.

Text isn't the only form of unstructured data—images are too. Computer vision faculty **David Forsyth** and **Derek Hoiem** have developed a data-driven

method to find the location of small but important things (aka "little landmarks") in pictures. One example is a car door handle, which by itself is indistinct and hard for a computer to locate.

"You can't find the handle directly because it doesn't have any distinctive pattern, so you've got to find something else that tells you where it is," explained Forsyth.

"We've created a system that learns the context automatically and learns a sequence of steps to find it," said Hoiem, who anticipates their method could have applications in robotics, helping a robot find a door handle or turn on a light switch. "This method is much more accurate at finding these hard to locate parts than something that is looking for the parts directly."

Hoiem is also developing a learning system that knows where to look in an image in order to answer a text-based question about the image. For example, his system can examine a photo of a stoplight and correctly answer a query about which color is lit up—a significant improvement over other models that also used the Microsoft Common Objects in Context (COCO) dataset.

According to Hoiem, his model takes a fairly simple approach, mapping natural language onto the image and scoring the various regions in the image for relevance in order to answer the question correctly. Ideally, he'd like to enhance the model so it can learn to perform specialized tasks like counting, reading, and recognizing activities in order to answer more complicated questions.

While advances in deep learning and vision are making it possible to automatically attach descriptions to images, many challenges still remain. CS Professor **Julia Hockenmaier** has built a probabilistic model that exploits certain knowledge from photo captions. According to Hockenmaier, captions contain a lot of common-sense knowledge about everyday events. For example, the computer can learn that if a person is holding a shovel, then he/she is probably digging a hole.

"This basic concept or world knowledge can be a bottleneck for the computer," she said. "We've shown that this can be really useful for solving certain kinds of semantic tasks that require inference."

Hockenmaier and fellow CS faculty member **Svetlana Lazebnik** have also created richer models of image captioning through their Flickr30K Entities project, which explicitly pairs the mention of objects in the caption to their corresponding image regions.

The process of creating and training new algorithms to make sense of unstructured data relies on humans to first sort, filter, label, or otherwise annotate the images, text, or video. Big companies like Facebook, Google, and Amazon hire tens of thousands of people each year through online crowdsourcing sites to complete these tasks. The companies then apply their machine-learning algorithms to the human-annotated data and generate machine-learning models that are applied to the rest of their datasets.

"These companies spend an inordinate amount of money on crowdsourcing," said CS Professor **Aditya Parameswaran**, noting that humans tend to be costly, slow, and error prone compared to computers. "It's hard to figure out the best way to have humans help analyze unstructured data."

Parameswaran has developed algorithms that rate workers based on their expertise, efficiency, and accuracy. "Our optimization algorithms could lead to significant reductions in cost, error, and latency," he said.

Not only is big data unstructured, but it can potentially be inaccurate. There are millions of living species and each has its own set of genes that number in the thousands. CS and Bioengineering Professor **Tandy Warnow** encounters these big datasets in determining the evolution of species.

"The problem isn't just the volume of data, but when you try to understand evolution by looking at modern day species and working backwards in time, each of these genes has its own story," said Warnow. "This heterogeneity across the genome makes it very hard to figure out the species tree."

A species tree describes how different species evolved from a common ancestor. However, the conventional methods of creating the tree generates some errors.

"The problem is that on a given gene, this information is usually wrong because gene trees aren't always accurately computed," Warnow said. "Often the error is small, but there is some error."

Over the last few years, Warnow developed a method to create more reliable gene trees. Known as *statistical binning*, her approach sorts all the genes into sets, which are combined to create supergene trees. These new trees, in turn, are combined to form a more accurate species tree.

Her statistical binning technique enables researchers to construct more accurate species trees detailing the lineage of genes and the relationships between species. In fact, Warnow's technique helped an international team of researchers produce the most reliable evolutionary tree of 48 species of birds in 2014.

Another development that is key to data science's emergence, according to CS Professor **Indranil Gupta**, is the ability to seamlessly run very large datasets on multiple machines. CS @ ILLINOIS systems-area faculty are exploring ways to make industry-standard programming frameworks like Hadoop and Storm run faster and be more tolerant of server failures. They also are finding ways to increase the efficiency of servers' run time as jobs are scaled up to take advantage of the processing power of more machines.

Hadoop and Storm, which are used to optimize data storage and workflow solutions, typically process both research (batch) jobs and time-sensitive production jobs simultaneously. For example, a production job that counts the number of clicks per ad on a website needs to run quickly and frequently. If the results are delayed for any reason, it could mean lost revenue. However, a research job that is trying to discover better ways to place ads might run on the same dataset, but its results aren't nearly as time sensitive.

Some organizations run separate research and production clusters and restrict the jobs that can be run on the latter. However, this can actually lead to longer run times during periods when many jobs are running.

In collaboration with Yahoo, Gupta has created a system that addresses this inefficiency by enhancing the Hadoop stack to support production jobs that have priorities. "Our system allows the higher priority jobs to get the resources in the same class," he said.

Illinois systems faculty are also addressing cloud computing research, in part, through the Air Force Research Lab-funded Assured Cloud Computing center, which develops technology for mission-critical cloud computing across secure military and insecure private networks. ACC is also ensuring the confidentiality and integrity of data and communications, job completion in the presence of cyber attacks and failures, and timely completion of jobs.

According to ACC Director and CS Professor **Roy Campbell**, Illinois researchers in the last four years have established that you can build mission-critical cloud computing elements, deliver real-time results to secure the cloud, and make the cloud reliable.

For example, Gupta has improved the functioning of NoSQL databases, which cloud systems frequently employ, and developed more advanced scheduling algorithms. His method efficiently makes configuration changes on the servers in the background while handling the reads, writes, and transactions in the foreground.

"The clients don't know that the reconfiguration changes have happened," said Gupta, noting that the current reconfiguration state of the art requires the database be shut down temporarily. "They just send the queries as normal."

Gupta has implemented his method into two industry systems: MongoDB, a document storage database used by the *New York Times*, and Cassandra, an open-source system used by Facebook and Netflix. "These are very impactful systems, so being able to make changes in them that directly improve the experience of system administrators and developers is really good," Gupta said.

While supercomputers are key to helping scientists solve complicated problems like predicting the weather, finding new oil reserves, and discovering new drugs, running an application on a petascale machine is expensive—more than $1,000 per hour. Ideally, that time would be used mainly for computation. In reality, a great deal of time is wasted while the machine reads, writes, and stores data.

CS Professors **Bill Gropp** and **Marianne Winslett** want to help scientists get the most out of their supercomputer time. In a recent study, they analyzed the behavior of over a million jobs from four leading supercomputers, including the U of I's Blue Waters machine, to look for ways to improve I/O performance. When they mined the performance data routinely collected on these supercomputers, they found common patterns of behavior that severely limit applications' I/O performance.

To address this problem, the researchers created an I/O analytics tool called Dashboard, which visualizes the high-level I/O behavior of an application across all of its runs. "Scientists usually run their applications hundreds to thousands of times, at many different scales, but I/O performance analysis tools weren't taking advantage of this," Winslett said.

With so many runs, scientific codes could essentially serve as their own benchmarks, the researchers realized. "With Dashboard, scientists and platform administrators get so excited when they literally see what's going on with I/O, across all the jobs of their application or platform," Winslett said. "Flagship applications used to get all the attention in parallel I/O research, but the Dashboard's data science techniques bring high-end performance analytics within the reach of all supercomputer users."

Professor Indranil Gupta

Professor Roy Campbell
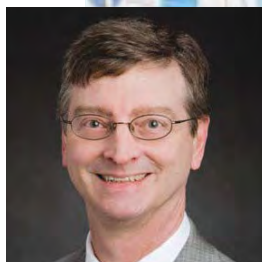
Professor Bill Gropp
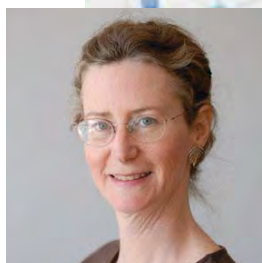
Professor Marianne Winslett

> ❝
> **[PEOPLE] KNEW HOW VALUABLE DATA WAS, BUT THEY DIDN'T NECESSARILY HAVE THE TOOLS TO DO SOMETHING WITH IT. WHAT IS WONDERFUL NOW IS OUR ABILITY TO DO THINGS WE COULDN'T DO."**
>
> **PROFESSOR DAVID FORSYTH**

THE DEMAND FOR DATA SCIENTISTS

The demand for data scientists is far greater than the supply, and universities are scrambling to create new curricula to train their students in this critical area. CS @ ILLINOIS faculty were among the first to offer advanced instruction through the Data Science Summer Institute for five years (2007-12). Dan Roth, Kevin Chang, David Forsyth, Jiawei Han, Cinda Heeren, and ChengXiang Zhai taught senior-level undergraduates and graduate students both theory and practical skills in machine learning, databases and information integration, natural language processing and information extraction, computer vision, and information retrieval and web information access.

According to CS Professor Indranil Gupta, Illinois is the only university offering MOOC specializations in both cloud computing and data mining. In fact, Gupta

> " **CS + X is breaking all new ground.** We're keen to engage with departments across campus because we think it's good for everybody. Our colleagues in other departments will pick up methods they haven't seen before as a result of co-teaching of students." — Professor David Forsyth

and his faculty colleagues Roy Campbell and Brighten Godfrey teach cloud computing concepts, applications, and networking through a Coursera specialization.

Of the nearly 125,000 students who registered for Gupta's course, several thousand actually finished, which is a typical completion rate for Coursera MOOCs.

"The number of students who finished are more than the total number of students who have taken all my classes at U of I in my 12 years as a faculty member," said Gupta, who plans to use the course videos to supplement his campus instruction.

CS @ ILLINOIS faculty are also having a big impact on data mining education. Han, Zhai, and John Hart reach tens of thousands of students through their Coursera MOOC specialization that covers text retrieval and search engines, text mining and analytics, pattern discovery, and data recognition.

Han's *Data Mining: Concepts and Techniques* textbook, which was first published in 2000 and is in its third edition, is one of the most widely adopted data mining books in the world. In another area, David Forsyth's *Computer Vision: A Modern Approach* is the standard textbook for that field.

CS Assistant Professor Aditya Parameswaran recently co-authored a book, *Crowd Sourced Data Management: Industry and Academic Perspectives*, which sheds light on the practice of hiring people to complete small tasks in order to train machine-learning algorithms. This is perhaps the first book that actually provides details on how crowdsourcing is used in practice.

While CS has had a joint degree program with math for decades, the department rolled out new undergraduate degree programs with the College of Liberal Arts in 2013. Students can now earn CS + X degrees in anthropology, astronomy, chemistry, linguistics, and statistics.

"CS + X is breaking all new ground," said Forsyth. "We're keen to engage with departments across campus because we think it's good for everybody. Our colleagues in other departments will pick up methods they haven't seen before as a result of co-teaching of students. Good for us, too, to be exposed to things outside our building."

Realizing that non-CS students were interested in learning how to extract knowledge from data, Computer Engineering senior Revanth Rameshkumar started the ASSOCIATION OF DATA SCIENCE & ANALYTICS, a campus-wide student organization whose mission is to lower the barrier of entry to the data science field.

"Data science and big data are really tough topics, and they are hard for students to master if they haven't had junior- and senior-level computer science courses," said Rameshkumar, whose interest in the field began with an introduction to machine learning as part of an internship at Boeing his freshman year.

ADSA core members conduct weekly workshops on data visualization, machine learning, relational and noSQL databases, and programming languages like Python and SQL. Industry experts like alumnus KEN TAYLOR (BS CS '81) from agriculture software company Agrible have taught the members how to use popular tools like Hadoop, Apache Pig, and Apache Hive.

CS alumni involved in the data science space are encouraged to share their expertise with ADSA members through either Skype or on-campus presentations. Please email Revanth Rameshkumar (rameshk2@illinois.edu) for more details.

Illinois to lead NSF Midwest Big Data Hub

BY KIM GUDEMAN, COORDINATED SCIENCE LAB

Big data could help unlock the mysteries of fields ranging from the natural sciences to medicine, and Illinois has a new opportunity to take a leading role.

To accelerate advancements in the rapidly emerging field of big data analysis, the National Science Foundation has given $5 million to establish four regional Big Data Hubs. The University of Illinois at Urbana-Champaign will lead the Midwest Big Data Hub, a consortium of public and private partners. Catalyzed by an initial award from the National Science Foundation called SEEDCorn, which stands for "Sustainable Enabling Environment for Data Collaboration," its goal is to provide a "big data brain trust" that will allow researchers to better collect, mine, and analyze data, leading to greater efficiency and, ultimately, a higher quality of life.

"The BD Hubs program represents a unique approach to improving the impact of data science by establishing partnerships among like-minded stakeholders," said Jim Kurose, head of NSF's Directorate for Computer and Information Science and Engineering. "In doing so, it enables teams of data science researchers to come together with domain experts, with cities and municipalities, and with anchor institutions to establish and grow collaborations that will accelerate progress in a wide range of science and education domains with the potential for great societal benefit."

Joining Illinois in the Midwest Big Data Hub are the University of Michigan at Ann Arbor, Iowa State University, Indiana University, the University of North Dakota and dozens of other partners from academia, industry, government, and non-governmental organizations. The Midwest BD Hub will focus its efforts on three sectors:

1. **Society** (smart cities and communities; network science; business analytics)
2. **Natural & Built World** (water, food, and energy; digital agriculture; transportation; and advanced manufacturing)
3. **Healthcare and Biomedical Research**

Those themes are a natural fit for the Midwest, which is sitting on the nation's largest freshwater reservoir and some of the country's most fertile soil. It's also home to top healthcare systems and pharmaceutical companies, such as the Mayo Clinic and Eli Lilly, both of which are partners in the Hub. In addition, the City of Chicago, another partner, is exploring many smart city concepts, such as smart traffic and transportation systems.

"Big data could help us determine, for example, how much water to use for raising food, how much for drinking, and how much to leave untouched,' said Edward Seidel, principal investigator of the Midwest BD Hub and director of Illinois' National Center for Supercomputing Applications.

CS Professor and Coordinated Science Lab Director Klara Nahrstedt is a member of the Midwest BD Hub's Interim Steering Committee and is leading the Food, Water, Energy working group. More details on the Hub can be found at midwestbigdatahub.org.

The other three regional Hubs will be coordinated by data scientists at Columbia University (Northeast Hub); Georgia Tech and the University of North Carolina (South Hub); and the University of California, San Diego, the University of California, Berkeley, and the University of Washington (West Hub).

Air Force Provides Grant to Develop Secure Cloud Computing Technology

Professor Roy Campbell

KIM GUDEMAN, COORDINATED SCIENCE LAB

The U.S. Air Force Research Laboratory (AFRL) has awarded a new $2 million grant to the Assured Cloud Computing University Center of Excellence (ACC-UCoE) at the University of Illinois. The Center, which began in 2011 with $4 million from AFRL and the Air Force Office of Scientific Research, focuses on advancing secure cloud computing science and technologies.

ACC-UCoE develops technology for assured, mission-critical cloud computing across "blue" and "gray" networks that ensures the confidentiality and integrity of data and communications, job completion in the presence of cyber attacks and failures, and timely completion of jobs to meet mission requirements.

CS Professor Roy Campbell, who leads the center, says that research has already yielded many results.

"In the last four years, we've established that you could build mission-critical cloud computing elements, that you could deliver real-time results to secure the cloud, and that you can make the cloud reliable," said Campbell, the Sohaib and Sara Abbasi Professor in Computer Science.

A computational cloud used in military applications may include both blue and gray networks, where "blue" networks are U.S. military networks, which are considered secure, and "gray" networks are those in private hands, or perhaps belonging to other nations, which are considered insecure. In order to reach mission goals, it is sometimes necessary to coordinate computation across a mixture of these blue and gray resources.

Campbell's team has improved the functioning of NoSQL databases, which cloud systems frequently employ, and developed more advanced scheduling algorithms. Researchers have increased the performance speed of these databases and demonstrated that they can be relied upon to finish a task on deadline—an important consideration for the military.

With the new round of funding, Campbell aims to develop new methods of managing real-time streaming in the cloud. As the industry is moving toward software-defined networking, he is looking at ways to apply the new approach to cloud systems.

Campbell says the research could save the government money by being able to use "gray" networks for missions instead of building huge networks to handle all of its needs.

"It's also going to provide an additional layer of protection, because we can apply computing resources more liberally to missions," he said. "The research provides more guarantee, allowing the armed forces to have more computing support for its work."
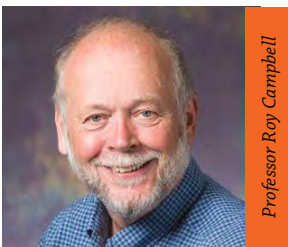
> **In the last four years, we've established that you could build mission-critical cloud computing elements, that you could deliver real-time results to secure the cloud, and that you can make the cloud reliable.**
>
> Professor Roy Campbell

NSF Grant Funds DataHub Project to Make Data Science More Collaborative

BY TOM MOONE

CS Assistant Professor Aditya Parameswaran is one of the leaders of a multi-university research project that recently received a $1 million grant from the National Science Foundation. Named DataHub, this project is intended to, in Parameswaran's words, "make collaborative data science simple."

DataHub is a collaborative platform for cleaning, storing, understanding, sharing, and publishing data sets being developed by Parameswaran and his colleagues Amol Deshpande of the University of Maryland and Sam Madden of MIT, who are co-PIs on the project. DataHub will be a publicly accessible platform that will host public or private user datasets.

There is a common problem among people who work with large data sets. As researchers work and make changes on a data set, they may want to keep a copy of the new set, but also retain the old one. The simplest solution is to make a copy to work on. Such copied data sets can quickly proliferate and expand the amount of storage needed for data research.

Parameswaran and his colleagues felt there had to be an easier way. Modeling their approach on GitHub, which had revolutionized source code version control, they thought, "Why not a similar repository for data sets?"

DataHub will include several key features: a flexible, source code control-like versioning system for data that efficiently branches, merges, and differences datasets; new tools designed to automate data cleaning process; the ability to search for "related" tables and to integrate them into the analysis process; and the ability to selectively share and collaborate on data sets across users and teams. Overall, DataHub will significantly reduce the amount of effort involved on the part of data scientists for preparing, analyzing, sharing, and managing data.

"It will handle the entire pipeline," Parameswaran said. "[DataHub will] allow people to work with data sets, do versioning, and do analysis. And we will also have other tools like data visualization, data integration all built in so that users don't need to go to other platforms for them. In a sense it is a one stop shop for data science."

DataHub will serve as a clearinghouse for data science, freeing up end users from tedious dataset bookkeeping tasks, and providing support for researchers. Because all three co-PIs were working on projects at MIT when they met and began the DataHub project, DataHub will be housed there. The code will be open source.

"This NSF grant is allowing us to develop the basic versioning technologies, allowing us to figure out how to store large numbers of versions of data sets efficiently," Parameswaran said. "The second thing we are doing is developing a query language or some sort of interface that will allow you to query over this large collection of data sets and retrieve ones of interest."

Professor Aditya Parameswaran

Kolla and Smaragdis Receive NSF CAREER Awards

Recently, CS Assistant Professors Alexandra Kolla and Paris Smaragdis received National Science Foundation CAREER Awards. These awards recognize outstanding junior faculty for research and teaching.

Alexandra Kolla

Paris Smaragdis

Kolla will use the funds from her award to better understand the limitations of approximation algorithms for solving combinatorial optimization problems. Also known as NP-hard, these types of problems are nearly impossible to solve quickly.

An example of an NP-hard problem is figuring out the shortest route for a package delivery driver that visits all homes within an area exactly once and returns to the starting point.

In practice, approximation algorithms are used to address complex issues like semiconductor chip design, airline scheduling, as well as package delivery—among other things. But how can one know when such an algorithm has reached its best approximate solution? Kolla aims to address that question with her CAREER-funded research by developing algorithms to disprove the Unique Games Conjecture (UGC), which, if correct, states that many of the problems people would most like to solve are not only NP-hard, but finding even a good approximation of the solution is impossible regardless of the computing power.

"We've come close to disproving [UGC] for a large class of problems, but there are still some cases left," she said. "With this project, we'll be attacking a large group of those cases to disprove the conjecture."

Smaragdis received his award to pursue research in machine listening. His research has been focused on developing algorithms and processes to extract a desired sound or group of sounds from a larger sound collection. With this CAREER Award, Smaragdis will begin working to scale up that research to work with very large amounts of sound data.

"For example if I were to scatter tens of thousands of microphones in a city so that I could monitor traffic, how would I be able to do this type of processing that many times in real time all the time?" said Smaragdis.

"We don't have the algorithms for that yet."

As part of this process, Smaragdis will also need to develop ways to train computer systems. "A lot of those algorithms require a bit of training, where you give [the computer] examples, [such as] this is how Paris's voice sounds. Now that you know how it sounds, you can try to extract it from a mixture," explained Smaragdis. "What we're proposing now is a different family of algorithms that would be able to scale for big data and for larger volumes of sound."

Godfrey Receives an ACM Rising Star Award

BY LAURA SCHMITT

CS Associate Professor P. Brighten Godfrey received the 2015 Association for Computing Machinery (ACM) SIGCOMM Rising Star Award for his research contributions to the network architecture field. By developing novel algorithms and combining them with insights into practical systems, he has been able to create new ways to address problems in routing, data center architecture, and network verification.

Professor Brighten Godfrey

Studies by Google and Amazon have shown that even small increases in network latency have a real impact on how people use interactive technology on the Internet. For example, people respond to delays of only a fraction of a second when browsing the web. Low latency is also critical for playing online games or conversing with audio or video.

Godfrey's research group is exploring the causes of latency, including why web pages take seconds to load—even over fiber. One major bottleneck: the time to resolve DNS requests—a key step in loading a web page. They have developed new technology to reduce latency in this important protocol, sending the same request to many different servers simultaneously, and using the first answer that comes back. This cuts DNS resolution time in half.

The rise of cloud computing and big data analytics have strained the architecture of data center networks, which must scale to increasingly large sizes with significantly more network traffic between servers. Godfrey has shown, surprisingly, that an unstructured uniform-random network topology is both more flexible and more bandwidth efficient than conventional rigid network structures. In fact, his Jellyfish network topology supports about 25% higher network capacity than an equally-priced fat tree network.

Another focus of Godfrey's research is to design and implement systems that automatically verify correctness of network behavior, and fix vulnerabilities and errors in operational networks. These systems can immediately help protect networks and critical infrastructure against real-world cyber attacks.

He and his CS faculty colleague Matthew Caesar co-founded Veriflow Systems, Inc. with Ahmed Khurshid (PhD CS '15) in 2012 to commercialize this research. The company's product, Veriflow, automatically verifies a network's data plane—the workhorse of switching elements that are critical to moving data over the Internet. The tool scans a network, constructs a model of its behavior, and uses proprietary algorithms to automatically detect network inconsistencies or errors in real time.

The SIGCOMM Rising Star award is presented each year to one researcher (age 35 or younger) who has made outstanding contributions to the field of communication networks.

Three CS Women among World's Top Rising Stars

BY LAURA SCHMITT

Three CS @ ILLINOIS researchers were among the top 60 women engineers and computer scientists worldwide to attended the 2015 Rising Stars academic career workshop at MIT in November: Jung-Eun Kim, Parisa Kordjamshidi, and Xiang Ni.

The two-day workshop included practical advice on leadership, preparing an academic statement and application, and navigating the faculty search and promotion processes, as well as informal time to network with fellow participants and workshop speakers from MIT and industry.

According to Kim, the workshop was valuable because it helped her understand the importance of being able to describe one's research. "You can be doing interesting work and be putting in tremendous effort, but if you fail to successfully convey the value of your work, then your academic career may suffer," she said.

JUNG-EUN KIM

A doctoral student in CS Professor Lui Sha's research group, Kim presented a talk at the workshop on a new real-time scheduling paradigm for safety-critical multicore systems. Currently, use of more than one core in a multicore chip is not yet certified for safety-critical applications such as avionics systems. Kim's novel approach, which synchronizes I/O transactions, assumes unknown task execution times, and employs budgeted generalized monotonic scheduling (Budgeted GRMS), may help enable safe use of multicore processors on such systems.

"I received good feedback about my work and my presentation from other participants and faculty, and that gave me good energy and motivation," said Kim. "What I've learned will definitely impact my career and decisions."

PARISA KORDJAMSHIDI

A postdoctoral researcher working in Professor Dan Roth's group, Kordjamshidi is working on a new programming paradigm called declarative learning-based programming. She is designing a new high-level language, Saul, that can be used to build intelligent systems since conventional programming languages don't facilitate the possibility of learning from messy real-world data.

"I'm very happy that this time and space was given to me," Kordjamshidi said. "This workshop helped me to be encouraged and think about my dreams and how I should plan now."
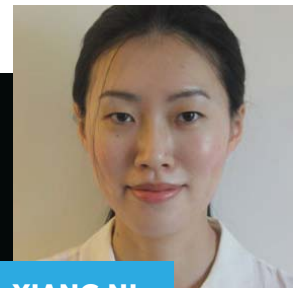
XIANG NI

A doctoral student in CS Professor Laxmikant Kale's research group, Ni presented her research on mitigating failures in high-performance computing through runtime techniques at the workshop. She is developing runtime system techniques that can be deployed to make large-scale parallel executions robust and fail-safe.

WCS Banquet Features Alumni Amato and Reedy

BY TOM MOONE

In conjunction with the CS @ ILLINOIS Alumni Awards celebration (see p. 6-9), the Women in Computer Science (WCS) student organization held their annual Student and Alumni Banquet. Faculty, students, and alumni gathered in Siebel Center to network and share a meal.

One of the regular features of the banquet is an address by an alumna, who presents a talk and gives career and life advice to the organizations members. This year, the banquet had the good fortune of featuring two alumnae, who were being honored at the Alumni Awards ceremony the next day: Nancy Amato (PhD CS '95) and Lynn Reedy (BS Math & CS '77).

Amato is the Unocal Professor of Computer Science and Engineering (CSE) at Texas A&M University, where she co-directs the Parasol Lab. Her research interests include motion planning and robotics, computational biology and geometry, and parallel and distributed computing.

Amato described what she termed her "accidental" path to becoming a computer scientist. It wasn't a goal for her early on, but as she followed her interests, the path led first to studying computer science at Illinois and then to a career as a college professor. Throughout her academic career Amato has been a strong advocate for encouraging women to become more involved in the field. As the program chair for the ICRA 2015 conference, she worked to ensure that conference had strong representation of the many women who are active in the field.

Amato told the audience, "You should seek the advice of people who are more experienced, but then you have to make the decision that is right for you. For me, that always worked out very well."

Reedy has worked in software and software development her entire career. During her tenure as senior vice president and CTO at eBay from 1999 to 2006, she led the complete redesign of the company's website—both hardware and software—without disrupting the auction site's operations.

Reedy's experience and career grew with each new challenge. Describing her time at eBay, she said, "We were constantly doing things that no one had done. We weren't sure how to do it, but we were successful."

Reedy stressed the importance of having goals and meeting challenges head on. She left the students with a favorite quotation from Michelangelo: "The greatest danger for most of us is not that our aim is too high and we miss it, but that it is too low and we reach it."

Both speakers left the students with the assurance that they could follow this advice and make some impact in the world and in their future careers.

Nancy Amato (left) and Lynn Reedy were the guest speakers at the WCS Student and Alumni Banquet.

Five CS Students Named Siebel Scholars

In recognition of their outstanding academic record and leadership, these students will each receive $35,000 during their final year of study.

"We are honored to have our students recognized each year through the Siebel Scholars Program," said Andreas Cangellaris, dean of the College of Engineering. "The students are all exceptional, and it's exciting to see their achievements recognized in this way. We know that they will continue throughout their careers to bring distinction to this university and the Siebel Scholars Program."

"It is my great pleasure to congratulate the Siebel Scholars Class of 2016 and to welcome them to this ever-growing, lifelong community," said Thomas M. Siebel, Chairman of the Siebel Scholars Foundation.

PEDRO BELLO-MALDONADO

Bello-Maldonado is focusing on solving partial differential equations using numerical methods and high-performance computing in computational fluid dynamics applications. He has done work as an intern at Oak Ridge National Laboratory, the San Diego Supercomputing Center, and the University of Amsterdam.

TARIQUE SIDDIQUI

Siddiqui is a member of the Databases and Information Systems Research Group (DAIS) working with CS Professor Aditya Parameswaran at the intersection of main memory database systems, human-computer interaction, and statistical machine learning. Currently, he is building a next-generation visual analytics platform for an interactive and exploratory analysis of large datasets. He had previously worked for Goldman Sachs on enterprise data management, complex event processing, and large scale distributed system problems.

SHASHANK YADUVANSHI

Yaduvanshi is building a fault-tolerance module for real-time data processing systems under the direction of CS Professor Marianne Winslett. He recently co-founded a company in India, TextMyPA, which will act as a one-stop solution connecting consumers to a wide range of online services. He is currently a summer intern at Pinterest. He had previously had an internship at Microsoft Research, and the work there resulted in a patent.

OREOLUWA ALEBIOSU

Alebiosu's research focuses on software testing and presents a variety of techniques to provide quality assurance in machine learning software. In 2015, he founded Lookin4, a mobile shopping application. Prior to Lookin4, he was a contributor to FlipWord, an award-winning student startup. He received a Google Scholarship in 2013, and in 2014 he was selected for the prestigious GEM Fellowship Program, which encourages the recruitment and retention of minority graduate students at select universities, including Illinois.
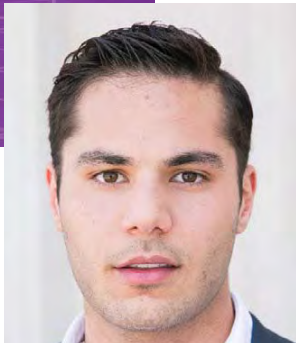
AVESTA HOJJATI

Hojjati is doing research in the Illinois Security Lab, where he works with Professor Carl A. Gunter. He has co-founded three companies: Security 7, which provided security services and penetration testing; Microsim Technologies, a technology firm which designed microfluidics applications; and Phalanx Investment Properties LLC, which invests in properties and new communities. He recently completed an internship at Yahoo! as part of the Paranoid Security Team.

About Siebel Scholars

The Siebel Scholars program was established by the Siebel Foundation in 2000 to recognize the most talented students at the world's leading graduate schools of business, computer science, and bioengineering, and now energy science. Each year exceptional students receive a $35,000 award during their final year of studies based on outstanding academic performance and leadership. Today, an active community of over 950 Siebel Scholars serves as advisors to the Siebel Foundation and works collaboratively to find solutions to society's most pressing problems.

This group has the unique opportunity to directly influence the technologies, policies, and economic and social decisions that shape the future. Siebel Scholars serve as key advisors to the Siebel Foundation, guiding the development of innovative programs the Foundation initiates. The Siebel Scholars community is also integral to a highly outcome-driven Siebel Scholars conference held regularly to explore critical social issues.

Photo by Priten Vora

ACM Reflections | Projections 2015

Organized entirely by student members of ACM, Reflections | Projections is the largest student-run conference in the Midwest.

BY LAURA SCHMITT

Billed as a tech conference, the 21st annual Reflections | Projections event held at Siebel Center in October drew more than 2,000 participants to its two career fairs (one for startups and one for established companies), interesting talks, and artificial intelligence programming competition. Organized entirely by student members of ACM, R | P is the largest student-run conference in the Midwest.

Among the event's stellar speakers were several CS alumni. Alan Braverman (BS CS '96), founder of the Giant Pixel startup studio, spoke to students about high-risk, high-reward careers, which he is well acquainted with through his startups Xoom, Geni, and Yammer. Anna Patterson (PhD CS '98), Vice President of Engineering for Artificial Intelligence at Google, gave advice about how to have a successful career as a software engineer, as well as tips for entrepreneurs. Greg Baugues (CS attended), a developer evangelist at Twilio, spoke about mental illness and how to overcome the stigma associated with it.

Yisong Yue (BS CS '05), an assistant professor at CalTech, talked about machine learning applications to sports analytics, data-driven animation, and personalized medicine. Jerry Talton (BS CS '03, MS CS '05), CEO of startup Apropose, which brings data-driven solutions to web design, spoke about startups, luck, and the mental toolset needed to accomplish great things.

While the main objective of the conference was to connect students with job opportunities and career advice, a major highlight was the AI programming competition, where teams of student programmers had one day to develop code that would attack and defend machine clusters on an emulated computer network. The winning team, Dr. Lego, received Oculus Rifts.

Thanks to event sponsors GoDaddy, Palantir, Microsoft, Intelligent Medical Objects (IMO), 3Red Trading, Bank of America, Capital One, Adobe, Sandia National Labs, Facebook, and Indeed.

Coursera Co-Founder Delivers 2015 Mueller-Thuns Lecture

BY TOM MOONE

On December 1, Coursera president and co-founder Daphne Koller delivered the 2015 Mueller-Thuns Lecture in Computer Science. She spoke on the history of Coursera and the impact that Coursera and massive open online courses (MOOCs) have had in their short history.

At Coursera, Koller leads the growth and nurturing of partnerships with over 130 universities and educational institutions. Previously, she was the Rajeev Motwani Professor of Computer Science at Stanford University.

Coursera developed out of a pilot project at Stanford in 2011 in which three graduate computer science courses—on machine learning, databases, and artificial intelligence—were put online for anyone to take for free. With no advertising other than a mention in a *New York Times* article, these courses that typically had a total of 400 Stanford students enrolled, suddenly had over 100,000 enrolled online.

"What was most striking was not the number, but the diversity," said Koller. "These were people from every country, every age group, and every walk of life that exhibited this need to have access to a high-quality education that many would never have had in any other way."

This eye-opening experience led Koller and some colleagues to form Coursera to expand on this experience and to partner with other universities and open up educational opportunities to people around the world.

One feature of the online environment is the ability to move at one's own pace. Course videos and other material can be reviewed as often as a learner wishes or needs over the course of a class. "In the online format, you have option to pause, reflect, maybe ask questions on a discussion forum, and get a chance to really get it before you move on," Koller said.

The University of Illinois and the Department of Computer Science are both developing and providing MOOCs through Coursera. At the department level, CS Senior Lecturer Lawrence Angrave was the first person to teach a MOOC on developing Android apps, and faculty in the department have developed multi-course Coursera specializations on Cloud Computing and Data Mining.

Robert Mueller-Thuns Lecture in Computer Science

The Robert Mueller-Thuns Lecture in Computer Science honors the memory of one of our distinguished graduates who died at a young age. This lecture series was established through memorial gifts by his wife, Nikki Mueller-Thuns Mirghafori (BS CS '91), family, friends, and colleagues.

Watch Dr. Koller's 2015 Robert Mueller-Thuns Lecture: http://bit.ly/1Rog9vH

Sha Receives Simon Ramo Medal

BY TOM MOONE

CS Professor Lui Sha and his colleagues John Lehoczky and Ragunathan Rajkumar (both from Carnegie Mellon University) were named co-recipients of the 2016 IEEE Simon Ramo Medal.

IEEE Medals are the highest distinctions that the IEEE presents, and the medals reflect the significant and broad IEEE interests and purposes. The three recipients of the Simon Ramo Medal are being recognized "for technical leadership and contributions to fundamental theory, practice, and standardization for engineering real-time systems."

The IEEE Simon Ramo Medal honors the distinguished engineering contributions of Dr. Simon Ramo, former vice chairman of the board and chairman of the executive committee of TRW, Inc. The medal is presented annually to up to three individuals in recognition of exceptional achievement in systems engineering and systems science.

"I am extremely honored to be a part of the team receiving this honor," said Sha. "It is always gratifying to receive recognition for our hard work, but receiving this recognition as a team makes it particularly meaningful."

Sha, the Donald B. Gillies Chair in Computer Science, and his co-recipients developed the Generalized Rate Monotonic Scheduling (GRMS) theory, which has transformed real-time computing standards and established the foundation for the development of modern real-time systems. Today, nearly every commercially available real-time operating system, real-time middleware, and real-time development tool, as well as the integrated modular avionics standard, support the use of their theory. GRMS has been the only real-time computing method approved for safety critical applications in civil aviation since the 1990s.

Their approach has revolutionized modern real-time system design and analysis, as former NASA deputy administrator Aaron Cohen said in 1992: "We now have a system that will allow [Space Station] Freedom's computers to budget their time, to choose between a variety of tasks, and decide not only which one to do first but how much time to spend in the process."

Sha was recently selected to join a NASA Advisory Council, a recognition that stemmed from his early contribution to real-time computing and recent work on complexity reduction and control architectures. He has received many awards including the David Lubkowski Award for the Advancement of Digital Avionics (2009) and the Award for Outstanding Technical Contributions and Leadership in Real-Time Systems from the IEEE Technical Committee on Real-Time Systems (2001). He is a Fellow of ACM and IEEE.

Over the course of his career, he has served as a member of the Office of the Secretary of Defense's Avionics Advisory Team, the National Academy of Science's committee on Certifiably Dependable Software, the peer review panel of Safety Critical Avionics Systems Branch at NASA's Langley Research Center, and the NSF's Planning Committee on Cyber Physical Systems on high assurance medical devices.

Warnow Named a Fellow of ACM

BY TOM MOONE

CS and Bioengineering Professor Tandy Warnow has been named a 2015 Fellow of the Association for Computing Machinery (ACM). In the citation for this award, Warnow is recognized "for contributions to mathematical theory, algorithms, and software for large-scale molecular phylogenetics and historical linguistics."

Warnow, a Founder Professor of Engineering, is an expert in the application of mathematics and computer science to developing algorithms for complex problems in the fields of phylogenomics (the intersection of evolution and genomics), metagenomics (the study of genetic material in the environment), and historical linguistics.

Warnow is recognized "for contributions to mathematical theory, algorithms, and software for large-scale molecular phylogenetics and historical linguistics."

In both the biological and linguistics aspects of her research, Warnow studies ways to understand and estimate the evolution of a collection of genes, species, or languages from their common ancestor. Her more recent research work has focused on the biological side. In this work Warnow has been focusing on developing methods that can analyze large complex datasets, and provide improved accuracy compared to existing methods, and then collaborating with biologists in using those methods on biological datasets.

Warnow has also contributed to mathematical theory in phylogenetics, and was part of a team of researchers that developed the first absolute fast converging (AFC) methods. These methods have a theoretical guarantee of reconstructing the true evolutionary tree with high probability given polynomial length sequences.

One of the projects Warnow works on is the Avian Phylogenomics Project, which was featured in a December 2014 special issue of *Science*. Warnow was the computational leader for the phylogenetic analyses of this project, which used the genomic sequences of 48 bird species to develop a new understanding of the evolutionary family tree of birds.

Warnow has also developed models and computational methods for the study of the evolution of languages. "Languages also evolve like species, and there are a lot of the same challenges. For example, just as there is horizontal gene transfer in biology, languages have "loan words", and so also have this kind of horizontal transfer." Warnow said.

ACM will formally recognize the 2015 fellows at the ACM Awards Banquet which is scheduled for June 2016, in San Francisco, California.

Among her many other recognitions an NSF National Young Investigator Award in 1994, a David and Lucile Packard Foundation Fellowship in 1996, a Radcliffe Institute for Advance Study Fellowship in 2003, and a John Simon Guggenheim Foundation Fellowship in 2011. Warnow served as the chair of the NIH study section on Biological Data Management and Analysis (BDMA) from 2010 to 2012.

Adve Named University Scholar

BY LAURA SCHMITT

CS Professor Vikram Adve was one of seven Urbana campus faculty members selected as a 2015 University Scholar—a distinction that recognizes faculty achievements as researchers, instructors, and members of broader academic communities. Adve has made influential contributions to compiler design and to programming languages, areas that are foundational to how software is developed.

"Past University Scholars have included many of the most distinguished and well-respected members of our faculty,"

said Adve. "It is both humbling and exciting to be included in this list."

Adve and his graduate student Chris Lattner (MS CS '02, PhD '05) created the innovative, award-winning LLVM Compiler Infrastructure, which has had a broad impact both on commercial products and on research.

As a University Scholar, Adve will receive $45,000 over three years to pay for travel to conferences, lab equipment, research assistants, books, or other purposes.

Nahrstedt Named One of 10 Women to Know

CS Professor Klara Nahrstedt has been named to the inaugural list of "10 Women You Should Know" in networking and communications by Networking Networking Women (N² Women), a program of ACM SIGMOBILE. Nahrstedt is the Ralph and Catherine Fisher Professor of Computer Science and the director of the multidisciplinary Coordinated Science Laboratory at the University of Illinois.

Nahrstedt, who joined the Illinois faculty in 1995, is a leading researcher in multimedia systems. Her fundamental work on

energy-efficient dynamic soft-real-time CPU scheduling for mobile multimedia devices and development of first energy-efficient OS for mobile multimedia devices, GRACE-OS, has been widely recognized in academia and industry.

"I feel truly honored to be in this prestigious list of the '10 Women You Should Know,'" Nahrstedt said. "This recognition gives me also a tremendous satisfaction that my research has been appreciated by the broader community."

Cinda Heeren Receives ASEE Teaching Award

BY LAURA SCHMITT

CS Senior Lecturer Cinda Heeren received the 2015 American Society for Engineering Education (ASEE) Illinois-Indiana Section Teacher of the Year Award. Along with a certificate and cash prize, she'll present an invited talk at the ASEE sectional conference in April 2016 at Western Illinois University.

According to ASEE Award Chair Carmine Polito, a civil engineering professor at Valparaiso University, Heeren earned the award for her creative teaching methodologies, positive impact on students, development of innovative courses, and work in community outreach. "The [CS @ ILLINOIS] community should realize how lucky they and their students are to have someone as talented and dedicated as Cinda as part of their team," Polito said.

Heeren teaches CS 225: Data Structures and Programming Principles, a challenging course that all CS and computer engineering majors must take. At the start of the fall 2015 semester, nearly 700 students were enrolled, but about 70 dropped the class during the first few weeks.

Thanks to Heeren's initiative, those students don't have to give up on their computer science aspirations. Instead, they are invited to take an evening remedial class to prepare them properly so they can retake the course the following semester.

"I feel like if they have to drop the course because they're not thriving, this is too big of a hit to take when you're a sophomore," she said. "[The remedial class] gives them a smaller community of people that are like them, and that's OK. It's nice to provide students with that level of attention at such a crisis point for them."

Heeren earned the award for her creative teaching methodologies, positive impact on students, development of innovative courses, and work in community outreach.

In spring 2015, Heeren and CS Teaching Assistant Professor Wade Fagen piloted a new course, CS 205: Data Driven Discovery, where the students learn to collect various types of data—images, text, numeric, geographic, or integrated—analyze the data, and then produce a visualization to illustrate what they learned from the data.

In addition to her innovative teaching and course development, Heeren oversees the CS @ ILLINOIS Gems Computer Science Camp for Girls, which teaches computing and other STEM skills to middle school girls each summer.

An alumna of the CS department, Heeren (PhD CS '04) jokes about being born to teach—both of her parents were teachers, and her uncles were professors. "Teaching is very much part of my cultural heritage," she said. "In terms of computer science, I'm also a poster child for NSF diversity programs."

As a faculty member at Illinois, Heeren has received several teaching awards, including the 2014 CS @ ILLINOIS Distinguished Educator Award and the 2014 College of Engineering Rose Award for Teaching Excellence. In addition, she was named a College of Engineering Academy for Excellence in Engineering Education Fellow.

Bailey Applies Crowdsourcing Solutions to Enhance Design Education

Professor Brian Bailey

BY LAURA SCHMITT

When CS Associate Professor Brian Bailey began teaching the department's user interface design course (CS 465) nearly a dozen years ago, 20 students were enrolled in the class. Today, more than 200 students take the class, where they work on self-selected projects like mobile interaction, web design, interactive games, or product design.

As enrollments increased over the years, Bailey found it increasingly difficult to provide timely feedback to the students on their concepts and designs—a critical step in successfully completing a project.

An expert on crowdsourcing and design innovation, Bailey had previously developed a web service that allowed people to get feedback on visual designs from either social media or a paid online audience. He wanted to explore whether this type of crowdsourcing solution could address the scaling problem in his course.

"The crowd-based systems give us an opportunity to connect with potential stakeholders at scale and very quickly," Bailey said. "We saw this type of crowd feedback system as a chance for students to acquire feedback on their projects whenever they want and as often as they want."

Bailey will test his crowd-based approach thanks to a recently awarded $1.3 million NSF cyber-learning grant that he shares with faculty colleagues Steven Dow at Carnegie Mellon University and Elizabeth Gerber at Northwestern University. They are investigating whether leveraging online crowds through social media and paid work platforms can be used effectively to provide formative feedback in the classroom and enhance design learning and innovation.

Bailey and his collaborators are developing a Crowd-Aided Feedback Technology (CRAFT) and studying its effect on design learning. "There aren't any principles on how to do [crowd] feedback optimally, and no one has studied the crowd's influence on the design process," said Bailey, who has found some evidence that his earlier crowd feedback system led to improved designs.

One goal of the research is to determine which type of crowd provides the most valuable feedback and which point in the design process is optimal for soliciting feedback. A second goal is to translate the feedback into an action plan by using annotation tools that groups the reviews into categories so that the students can understand the aggregate feedback more quickly.

Finally, Bailey said, CRAFT will enable the creation of a design canvas, where designers can construct a visual representation of their creative process. "The crowd would have access to the designer's history," he said. "They'd see different iterations of the design up to the present."

Not only will educators have access to CRAFT, but designers and engineers anywhere will be able to access it online. "The students can continue to use it, but people pursuing entrepreneurial activity, hobbies, or their own professional interests can also get feedback on their ideas."

ChicTech
Introduces High School Girls to Computer Science

BY TOM MOONE

On November 7, Siebel Center greeted 49 high school girls who had arrived to take part in the ChicTech (sheek-tek) retreat put on by Women in Computer Science (WCS). Assisted by over 40 volunteers, the high school students received an introduction to technology and the culture of CS @ ILLINOIS.

CS @ ILLINOIS junior Brianna Ifft was the director and primary organizer for this year's event. She and her team of volunteers and assistants worked together to give the attendees a valuable and inspiring weekend. The attendees arrived starting at 8:30 on the Saturday morning, and left Sunday afternoon at 2:00 p.m.

Three workshops held during ChicTech focused on Scratch, HTML, and JavaScript. Other activities (such as a scavenger hunt in north campus) encouraged attendees to work together, get to know one another, and see more of the Illinois campus.

Students had a great time, as indicated by their feedback. "Some said it was life changing," Ifft said. "They really liked meeting girls who were like minded as them or who were pursuing similar goals."

In the post-event evaluations, one participant said, "Thank you girls so much for this amazing experience! I had so much fun and learned a lot too!"

Ifft started working on the event in the spring semester. Over the course of the summer, she developed a budget and solicited corporate sponsorship. In the fall, she started looking for volunteers and worked on the finer details of the event.

The event was run as a partnership between the CS Department and WCS, with the department underwriting the cost. CJ Coleman, CS @ ILLINOIS associate director of external relations, said, "CS @ ILLINOIS is committed to supporting outreach programs to introduce CS concepts to women and underrepresented populations of all ages. We look forward to keeping in touch with our attendees to help foster their interests in CS."

And Ifft is an example of how ChicTech can help foster these interests. She was a particularly strong advocate for this year's ChicTech because she had been a participant when she was in high school. That experience "was really impactful for me," Ifft said. "It helped me decide where I wanted to go to college. And, I got to meet all the WCS girls. I felt that I already had a community when I came here."

# Gems Encourages Young Women's Interest in Computer Science

BY LAURA SCHMITT

With generous support from CS @ ILLINOIS alumni, the department once again sponsored the weeklong Gems Computer Science Camp for Girls at Siebel Center during the summer. Nearly 140 middle-school girls participated in three separate camps—each offered twice and at no cost to participants—that showcased how computer science applies to other interesting fields.

According to Heather Zike, CS undergraduate academic advisor and Gems manager, the girls learned how computing impacts the arts, fashion, and game design. They also interacted with dynamic undergraduate students, who developed and taught the fun, hands-on curricula for each session with help from CS Lecturer Cinda Heeren.

CS students Sylvia Haas, Mylene Haus, Laura Licari, Aashna Makkar, Lily Sellers, and Robin Sheong not only led the instruction but also served as mentors for the participants.
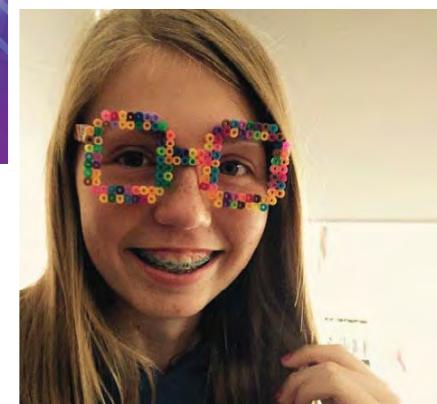
"Through our interactions, we showed [the girls] that we're like them—we watch *Teen Wolf*, paint our nails—but we also do computer science," said Haas, who participated in Gems six years ago when it was managed by NCSA on campus and run, in part, by men. "The girls could see us as role models."

The undergraduate leaders helped participants learn to program in JavaScript, design their own computer games and animations, and make LED bracelets and images that were printed on canvas bags. The whole teaching process had a big impact on CS junior Sheong.

"This was the first time that I actually got to design a curriculum from the ground up, which was both challenging and rewarding," Sheong said. "It was a joy to see the campers get engaged in creating games of their own, and I was so glad when I heard that they wanted to continue working on their projects even after Gems. I hope that the campers learned as much from me as I've learned from them."

Overall, Zike said the camp was a resounding success. CS @ ILLINOIS plans to expand the program next summer to include opportunities for even more middle school girls, and plans are in development for a camp for high school girls.

"I want to help grow the outreach with Gems and other programs," Zike said. "Every kid is interested in some form of technology, so we can show them how to apply computer science to their interests."

Dickey's Startup Company Supports Undergraduate Scholarships

A prolific software designer and entrepreneur, Roger Dickey (BS CS '05) has maintained a strong relationship with CS @ ILLINOIS and the campus community. During several campus visits he has shared his time, expertise, and career advice with students through alumni panel discussions, job fairs, as a CS Engineer in Residence, and as a panelist in the tech component of the Champaign-Urbana-area Pygmalion Festival. He has hosted and judged pitch competitions, and actively recruits engineers across several fields including machine learning, programming languages, and general computer science or computer engineering.

Earlier in his career, Dickey launched a social gaming startup of Facebook applications and games, including the widely popular Dope Wars. After his company was purchased by Zynga, Dickey developed MafiaWars (100 million users), FishVille (35 million users), and five other titles. In addition, he served as an international product team advisor for Zynga, helping the company grow its markets in Asia.

A 2012 recipient of the CS @ ILLINOIS Distinguished Alumni Achievement Award, Dickey is an investor with the storied Y Combinator, a seed fund that provides funding, advice, and connections for startup companies, including successful firms such as Dropbox, Airbnb, and Reddit.

> **The world needs more great engineers, and the EVS initiative supports that mission.**
>
> Roger Dickey

Recently, Dickey decided to give back in another way—he made a leadership gift through his company, Gigster, to support CS undergraduate scholarships as part of the College of Engineering's Visionary Scholarship (EVS) initiative.

"I had a great experience as a student at Illinois and want to support current and prospective students as much as possible," Dickey said. "The world needs more great engineers, and the EVS initiative supports that mission."

Dickey is the co-founder and CEO of Gigster, a hot new startup that pairs companies who have specific software projects with Silicon Valley-based product managers and top-notch developers who can complete those projects. To date, Gigster has raised more than $12.5 million in venture-backed funding, is actively hiring, and is well on its way to pursing the vision to become the world's engineering department.

The Engineering Visionary Scholarship Fund

CS continues to draw students who represent the best of Illinois and the nation. However, we are losing some of these top students—from all backgrounds and financial situations—due to a lack of scholarships. The department is actively building its scholarship endowment to be able to provide larger, renewable scholarships to more students. We need help from our alumni, friends, and corporate partners to help CS @ ILLINOIS ensure that cost alone does not put an Illinois education out of reach.

For more information about this and other giving opportunities, visit: http://cs.illinois.edu/why-give.

Celebration of Excellence
Student Awards

Each semester, CS @ ILLINOIS honors students who have received important distinctions. We extend congratulations to these individuals whose hard work is a credit to themselves and a source of pride for the department.

ROBERT KAUCI (class of 2019) was a National Merit Scholar and the President of the National Honor Society in his high school, where he ran varsity cross country and track. He captained competitive Computer Science and Science Bowl teams and coordinated community service events. At Illinois, he is a Chancellor's Scholar and plans to pursue research in virtual reality.

Graduate Fellowships & Awards

3M FOUNDATION FELLOWSHIP
Silu Huang
Bryan Plummer
Sheng Wang

ANDREW AND SHANA LAURSEN FELLOWSHIP
Shashank Agrawal
Stephen Macke

BECKMAN GRADUATE FELLOW
Cassandra Jacobs

CHIRAG FOUNDATION GRADUATE FELLOWSHIP IN COMPUTER SCIENCE
Yi-Chieh Lee
Tuo Yu

COMPUTER SCIENCE EXCELLENCE FELLOWSHIP
Nitish Gupta
Renato Mancuso
Lucas Pena
Muntasir Rahman
Giordano Salvador

DEBRA AND IRA COHEN GRADUATE FELLOWSHIP IN COMPUTER SCIENCE
Pranjal Vachaspati

DIFFENBAUGH GRADUATE FELLOWSHIP
Stephen Macke

GENERATION GOOGLE SCHOLARSHIP
Angello Astorga

GOOGLE PHD FELLOWSHIP
Muhammad Naveed

GRADUATE COLLEGE DISTINGUISHED FELLOWSHIP
Lucas Pena

IBM PHD SCHOLARSHIP
Shen Li

JUMP TRADING FELLOW
Abhishek Harish

MAVIS FUTURE FACULTY FELLOW
Matthew Sinclair

NATIONAL DEFENSE SCIENCE & ENGINEERING GRADUATE FELLOWSHIP
Ahmed El-Kishky

NSF GRADUATE RESEARCH FELLOWSHIP
Chase Geigle
Stephen Macke
Erin Molloy
Giordano Salvador

NSF GRADUATE RESEARCH FELLOWSHIP, HONORABLE MENTION
Bryan Plummer
Yipu Wang

OUTSTANDING TEACHING ASSISTANT, SPRING 2015
Assma Boughoula
Codruta Girlea
Shelley Goel
Terence Nip
Nikita Spirin

RAY OZZIE COMPUTER SCIENCE FELLOWSHIP
Wing Lam
Siwakorn Srisakaokul

RICHARD T. CHENG ENDOWED FELLOWSHIP
Patrick Lin
Jung Eun Kim

SABURO MUROGA ENDOWED FELLOWSHIP
Colin Graber
Pranjal Vachaspati
Seyed Amirhossien Mirhosseini Niri
Alexandra Nilles
Peter Sentz

SIEBEL SCHOLAR
Oreoluwa Alebiosu
Pedro Bello-Maldonado
Avesta Hojjati
Tarique Siddiqui
Shashank Yaduvanshi

SOHAIB AND SARA ABBASI COMPUTER SCIENCE FELLOWSHIP
Wajih Hassan
Faria Kalim
Muhammad Huzaifa
Muhammad Naveed
Rashid Tahir
Shayan Saeed
Hashim Sharif

STATE FARM COMPANIES FOUNDATION DOCTORAL SCHOLAR
Angello Astorga
Stephen Mayhew
Kent Quanrud

SURGE FELLOWSHIP
Giordano Salvador

THOMAS M. SIEBEL FELLOWSHIP
Erin Molloy

VMWARE GRADUATE FELLOWSHIP
Soudeh Ghorbani

WING KAI CHENG FELLOWSHIP
Suhansanu Kumar
Keyang Zhang

W.J. POPPELBAUM MEMORIAL AWARD
Matthew Sinclair

Undergraduate Scholarships & Awards

CHANNING BROWN SCHOLARSHIP
Matthew Rasmussen

CHAN-TSAI SCHOLARSHIP
Gary Rudolph

COMPUTER SCIENCE DIVERSITY SCHOLARSHIP
Riley Basaran
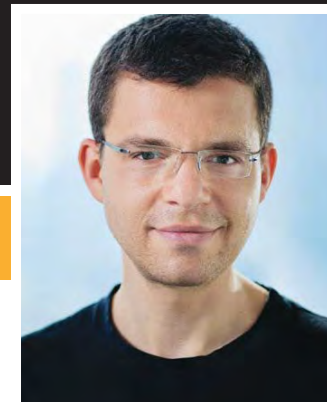Kody Puebla

FRIMA LUKATSKAYA SCHOLARSHIP
Robert Kaucic

JOHN DEERE & COMPANY SCHOLARSHIP
Jennifer Cheng
Brianna Ifft
Shannon Strum
Robin Sturm
Karunya Tota

JP MORGAN CHASE WCS SCHOLARSHIP
Paige Kordas
Jing Huang

ROWE FAMILY SCHOLARSHIP
Steven Schmidt

SANDRA L. AND JOHN P. RANKIN ENGINEERING SCHOLARSHIP
Cheyenne Lam

SARA AND LOUIS COHEN UNDERGRADUATE SCHOLARSHIP
Paul Rosa

SPYGLASS ENDOWED SCHOLARSHIP
Monika Janas
Ellen Ni

STATE FARM COMPUTER SCIENCE SCHOLARSHIP
Patrick Hurtado
Salina Ortega
William Robbins
Lily Zahn

SUSAN SILVER AND ROSS ERLEBACHER SCHOLARSHIP
Polina Volodina

WILLIAM AND RUTH WITT SCHOLARSHIP
Anna Veselova

Grace Hopper Celebration Awards

CS GRACE HOPPER CELEBRATION GRANT
Vera Liao
Le Xu

YAHOO! GRACE HOPPER CELEBRATION SCHOLARSHIP
Mylene Haus
Robin Sturm

CISCO GRACE HOPPER CELEBRATION SCHOLARSHIP
Eva Shih

WCS GRACE HOPPER SCHOLARSHIP
Jennifer Cheng
Hannah Koh
Corly Leung
Annie Rong

MAX LEVCHIN (BS CS '97) is the CEO of Affirm, an online lending company, and Chairman of Glow, an infertility app, both launched from Hard Valuable Fun (HVF), his innovation lab. Previously, Levchin co-founded PayPal as well as founding and serving as CEO of Slide. He established the Frima Lukatskaya Scholarship in honor of his grandmother, who, through her remarkable life and career in science, taught him that talent and knowledge must be catalyzed by relentless drive to achieve excellence.

Support CS Students

Many of these awards and scholarships are made possible by generous donations from alumni and corporate partners. If you would like to support an existing fund or create a new one, please contact Director of Advancement Michelle Wellens at mwellens@illinois.edu for more information. Gifts are always welcome to support the CS Engineering Visionary Scholarship Fund, which helps us give more and larger scholarships to deserving students. For more information about giving opportunities, visit: http://cs.illinois.edu/why-give.

Gifts in Action: Gear Establishes Legacy Gift to CS

BY LAURA SCHMITT

Bill Gear (MS '57, PhD '60), a pioneer in numerical analysis who spent 32 years at Illinois—first as a graduate student and later as a professor and department head—was always grateful for the great education and research opportunities he had when he was young. A native of England, he attended Cambridge at no cost and pursued graduate studies at Illinois thanks to education grants and fellowships.

"I benefited from a lot of government programs that are regrettably no longer available to today's students," Gear said. "So, I wanted to give something back that will help future students."

Recently, Gear and his wife Ann Lee Morgan established a bequest (simple language added to their will with a corresponding fund agreement on file with the UI Foundation) that will provide financial support to CS @ ILLINOIS students and/or faculty, depending on the future value of their residual estate.

The C. William Gear Endowment in CS may be used to fund a new professorship or enhance funding for the three existing faculty and student awards that bear Gear's name—awards that were established by his former students, other alumni, and faculty colleagues as a way to honor his dedicated service to the department.

In addition to being a faculty member, Gear served as department head for five years. Under his leadership, the department increased the number of faculty from 30 to 45, expanded the Digital Computer Lab, and launched an alumni newsletter.

As a researcher, Gear is perhaps best known for developing a new method for solving stiff differential equations, a type of problem related to systems that involve processes that happen on highly disparate time scales. The Gear Method has been used to calculate the degradation rate of steel containment vessels in nuclear reactors and analyze the time-dependent behavior of electronic circuits, among other uses.

After retiring from Illinois, Gear became president of the NEC Research Institute in Princeton, NJ. He received the U of I's 2001 Alumni Achievement Award, is a member of the National Academy of Engineering, and is a fellow of the IEEE, American Academy of Arts and Sciences, and Society for Industrial and Applied Mathematics (SIAM).

"Bill Gear is a towering figure in our discipline, based on his foundational technical contributions and remarkable leadership at the helm of our Computer Science Department. Having his name associated with CS @ ILLINOIS in perpetuity is the perfect way of connecting future generations to Bill's importance to the department," said current CS Department Head and Abel Bliss Professor Rob A. Rutenbar.

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:

University of Illinois Computer Science

CS Professor Sanjay Kale spoke to *The News-Gazette* about Charmworks, his startup based in EnterpriseWorks at the University of Illinois Research Park. http://bit.ly/1U0uigu

CS 498 SL: Virtual Reality held an open house on December 16 to show off the many innovative and intriguing projects that students completed this semester. The projects included a 3D look into the Mogao Caves of China, a flight simulator to help pilots avoid midair collisions, immersive virtual classrooms, and a rehabilitation game for children with cerebral palsy.

CS graduate student Shashank Yaduvanshi is part of a team that has developed a women's safety app "Pukar," which has now become a hit with women in India. http://bit.ly/1Q3chNv

Congratulations to alumna Kamilah Taylor (MS CS '10) , who was named one of "7 Black Engineers You Need to Know" by People of Color in Tech. http://tcrn.ch/1OmT4px

@IllinoisCS

CS Prof. Steve LaValle spoke w/ @ChicagoInno about the future of #virtualreality, as @oculus preorders start today. http://bit.ly/1KhEEmy

Congrats to Ray Ozzie @rozzie (BS '79), whose communications startup, Talko, will join Microsoft's Skype team. ow.ly/Wc0oC

Raj Karmani (PhD '13) & @zeropercent has a plan to end Chicago Food Deserts. http://bit.ly/204KbGl

CS @ ILLINOIS

Engineering at Illinois had a great year of amazing achievements in 2015. Several CS @ ILLINOIS people and accomplishments are featured in this retrospective video. http://bit.ly/1IQU6Li

Excited about a Thanksgiving break project I did with the kids: we set up a Minecraft server on the Raspberry Pi! http://bit.ly/1J72hTT

College of Engineering Dean Andreas Cangellaris responds to *Chicago Tribune* article "Tech Talent Often Grows Away": "The University of Illinois at Urbana-Champaign is a global source of tech talent, and it is one of this state's greatest assets." http://bit.ly/1Q39y6D

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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: **go.cs.illinois.edu/KeepInTouch**

THIS YEAR CHICTECH INCLUDED 49 PARTICIPANTS
AND OVER 40 VOLUNTEERS. SEE ARTICLE ON PAGE 36.

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To see the CS Master Calendar, please visit:
go.cs.illinois.edu/calendar