PURDUE UNIVERSITY

COMPUTER SCIENCE

2015 Annual Report

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DEPARTMENTAL AREAS

Jesica E. Hollinger, *Producer*
Andrew Edmonds, *Graphic Designer*
Stephanie C.W. Holley-Kline, *Editor*

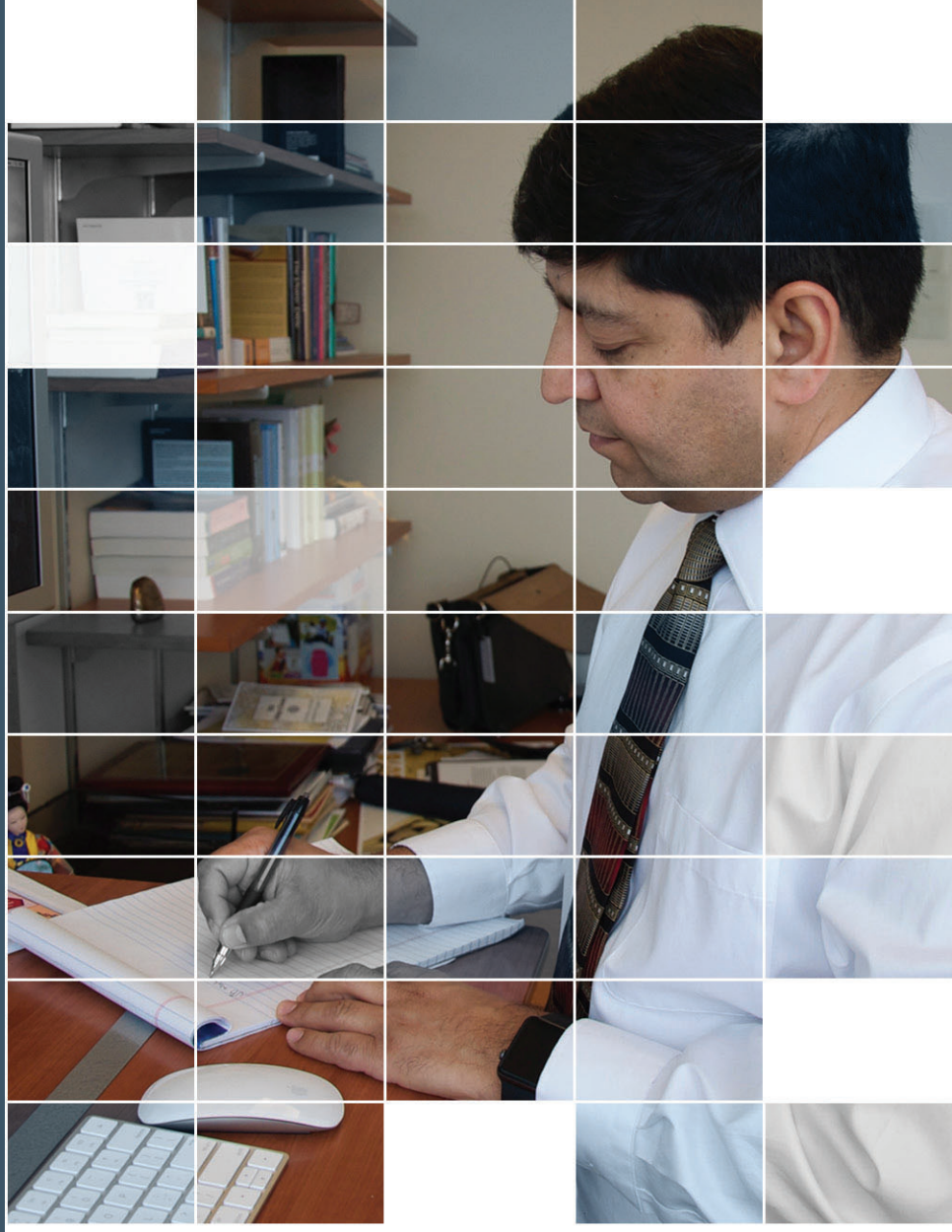
MESSAGE
FROM THE HEAD

May you live in interesting times – never before has that old adage been more true! Two years ago, we were selected as one of the *Purdue Moves* – a strategic area in the STEM sciences targeted for growth. Since then, we have been in the process of expanding our entire department by nearly 30%. The changes occurring have been transformational.

Through this time, we've made great strides and had much to commemorate – especially the vast achievements of our exceptional faculty. Professor Mike Atallah won the 2015 ACM CCS Test of Time Award for his paper published 10 years ago at the ACM's Conference on Computer and Communications Security (CCS). This prestigious award is given in recognition of his contributions, which have a sustained relevance and lasting impact on current and future research. Mike also won the prestigious Sigma Xi Research Award – an award that shares a roster of many notable Nobel Prize recipients. Wojciech Szpankowski, Saul Rosen Professor of Computer Science and Director of the Center for the Science of Information, was named Distinguished Professor by the Purdue Board of Directors. Earlier in the year, he was presented with the Ardent Behment Research Award, one of the university's highest research awards. A well-deserved tile and award for a visionary leader and renowned scholar in the field of Information Theory!

Our junior faculty are making significant advances, too. Assistant Professor David Gleich is among the elite chosen by the Alfred P. Sloan Foundation to receive one of the coveted Sloan Research Fellowships. David is one of only 126 individuals named by the Foundation as an "Early career scientist of outstanding promise." Assistant Professor Elias Barenboim – one of our recent hires – was named one of AI's 10 to Watch – a list of young stars recognized for their potential by the Institute of Electrical and Electronics Engineers (IEEE). These are just some of our faculty who are making remarkable contributions! Meanwhile, I'm proud to report we've added 15 new individuals to join the ranks of our faculty family, with hopes of hiring 10 new members, before the expansion concludes.

On the departmental side, we've also launched some bold initiatives – like the creation of a free, online programming course that is available to any high school student in the country. The course was designed to help students who've had little or no exposure to programming in high school, desiring to pursue a computer science degree and prepare for the AP qualifying exam. Creating a more diverse student population has also been one of our strengthened commitments. In our efforts to be successful, we hired a designated Director of Diversity, who will help us better serve and recruit underrepresented populations. We also forged a partnership with Google and the National Center for Women & Information Technology to help increase our female enrollment. On the graduate level, we launched a new Professional Master's Degree in Information Security for working professionals.
So much is going on and so much is ahead! It has been my privilege to lead during these interesting times . . . lead with loads of help from a dynamic faculty and staff who help me keep the department "*moving*" forward.



Here are some of our accomplishments:

- **We have record enrollment** in our student population—surpassing our 2017 goal.
- **We hired 15 new faculty members,** and plan to hire 10 more.
- **We launched a Master's Degree** in Information Security for working professionals.
- **We created the Bridge Program** to improve freshman retention rates – it already has!
- **We offer a free,** online programming course to any high school student in the country.

Celebrating A CAREER OF ACHIEVEMENTS - TIME AFTER TIME

It's been quite the year for Mike Atallah, Distinguished Professor of Computer Science.

A little more than 10 years ago, he published a paper titled Dynamic and Efficient Key Management for Access Hierarchies. This year, the paper was celebrated and recognized with the prestigious 2015 ACM CCS Test of Time Award at ACM's Conference on Computer and Communications Security (CCS). This significant award is given to a paper published 10 years ago that has remained relevant and vital in today's scholarship, with an enduring impact on the field.

With 352 citations, his paper has solved the key hierarchy problem in a very elegant way. Authors of different backgrounds ranging from algorithms to computer security to theoretical cryptography all cite his paper, and his work unifies different streams of work in those fields. The solution and its construction are still valid and used today – a building block in many other constructions for other researchers. According to his colleague Professor Greg Frederickson, Mike's paper brought the cryptographic enforcement of access hierarchies to a new level. His paper contributed (for the first time) to a cryptographically sound formal security definition. Previous work rooted in the security literature had used heuristic security notions. His paper clarified the distinction between the attacker's two goals of recovering keys or even distinguishing keys at random. Only the first, weaker notion had been considered before, but the second notion is satisfactory in the cryptographic literature.

And the hits keep coming . . . as if the Test of Time award wasn't enough . . . Mike also was recognized with another huge award this year – the Sigma Xi Scientific Research Award. This distinguished award shares a history with more than 200 alumni that were also Nobel Prize recipients, including Albert Einstein and Jane Goodall. The only other member of the CS department to earn the award occurred in 1994, when John Rice, former professor and department head was selected. Recipients are evaluated on the merits of their scientific research accomplishments, rather than their service to the university or other career accomplishments. Applicants select five of their most significant publications/ patents – no small task for a guy who has more than 258 publications and eight patents. Another of Mike's major achievements (that led to earning this award) include his paper, "Protecting Software Code by Guards" co-authored with his (then) graduate student, Hoi Chang. This paper was the impetus for Arxan Technologies Inc. that was developed with the assistance of Chang, Distinguished Professor Emeritus John Rice, Former Assistant Head Tim Korb, and local entrepreneur, Eric Davis. The technology they established is one of the leading providers of software security solutions. In 2013, Arxan was acquired by TA Associates, a private equity firm.

While 2015 was a particularly good year for Mike, there have been many good years and major successes along the way, since beginning his career with the Department in 1982. Mike has racked up his share of notable achievements. In 2013, he was recognized by the University with the Purdue Outstanding Commercialization Award, which is given to a faculty member whose outstanding contributions have led to, and had success with commercializing Purdue research discoveries. Additionally, he is a Fellow of the ACM and IEEE, won the NSF Presidential Young Investigator Award early in his career, was selected for Purdue's Book of Great Teachers, was named Outstanding Teacher of the College of Science, won the Purdue ACM Outstanding CS Instructor Award four times, and was recognized by his alma mater with the Distinguished Alumnus Award by the American University in Beirut.

On top of all that, Mike is a really a great guy – known for his thoughtful manner and dry sense of humor. Department Head Sunil Prabhakar said he has worked as a colleague of Mike's for nearly 20 years and considers him one of the brightest, yet humblest faculty members he's ever known. "Our department is so fortunate to have a diamond, like Mike, among us," Sunil said. "Mike deserves all of the tremendous recognition he is getting and much more. His research contributions elevate the entire stature of our department and we are all so pleased to have one of the world's most notable scholars in information security among us."

The body of Mike's work falls under the broad category of designing efficient solutions to important computational and information-security problems, where "efficiency" is in terms of computation time, storage space, network communication, economic cost, and a combination thereof. His work has spanned both the traditional framework, and the parallel/distributed, including cases in which the computation involves multiple parties that do not trust each other.
His fellow winners and co-authors of the paper were two of the department's PhD students under his advisement. Both have proved successful since his instruction. Marina Blanton went on to become Assistant Professor of Computer Science and Engineering at Notre Dame University, while Keith B. Frikken works as a software engineer at Google.

GLEICH'S POTENTIAL & CONTRIBUTIONS

GARNER THE ESTEEMED SLOAN RESEARCH FELLOWSHIP

It's a big deal – not often do you get to see your name in the New York Times with some of the most prominent computer scientists in the nation. It happened for Assistant Professor David Gleich this year, who found himself the first recipient from the CS Department to receive the esteemed Sloan Research Fellowship.

Only 126 researchers were selected for the annual award, which is given to recipients for their distinguished performance and unique potential to make substantial contributions to their field. Gleich was selected for his research that deals with enabling currently infeasible analysis of large data in science and engineering. "The software I've written based on this research has been used to study reducing jet-noise from new airplanes, to study how to identify different types of tissue in an MRI scan, to find groups of related proteins between different animals, among even more diverse uses," he explained.

The Sloan Fellowship began in 1955, and Computer Scientists were added as a category in 1993. Since then, only 16 individuals in computer science have received the fellowship. Gleich said he was both surprised and honored when he learned the news, while listening to a PhD defense from a student with whom he'd been working closely. "It was a challenge not to smile during his defense and maintain the serious demeanor required of us as professors," Gleich said. "I feel very grateful to the variety of mentors that I've had over my life and hope this selection will make them smile, like it made me smile," he added.

The Sloan fellowships are designed to inspire fundamental research by early-career scientists and scholars of outstanding promise, providing $55,000 for a two-year period that may be used for equipment, technical assistance, professional travel, trainee support, summer salary, or other activities directly related to the Fellow's research. Gleich said his fellowship would greatly benefit his work and allow it to evolve in many different ways. "This fellowship enables me to pursue some of the riskier directions that have the highest potential impact on society," Gleich said. "It also will provide resources to continue to make high-quality software based on this research available for others to use," he added.

The Alfred P. Sloan Foundation is a philanthropic, not-for-profit grantmaking institution based in New York City. Established in 1934 by Alfred Pritchard Sloan Jr., then-President and Chief Executive Officer of the General Motors Corporation, the Foundation makes grants in support of original research and education in science, technology, engineering, mathematics, and economic performance.

CENTER FOR SCIENCE OF INFORMATION:

NSF RENEWS GRANT THROUGH 2020

In 2010, the Center for Science of Information (CSoI) received a $25 million, five-year grant by the National Science Foundation (NSF) to advance the next generation of information theory through collaborative research and teaching. By developing methods for analyzing the extraction, manipulation, and exchange of data, CSoI's researchers apply information to problems in physical science, social science, and engineering. In 2015, NSF awarded CSoI with another five-year, $23 million grant. This funding will allow the Center to continue its innovative work that impacts research in virtually all of the scientific fields.

Led by Purdue CS professor Wojciech Szpankowski, CSoI engages in multi-institutional, grant-supported investigations that extend the scope of information science. The Center now boasts a partnership of eleven universities throughout the country having added the University of Hawaii in 2015. Although researchers from each institution bring their own unique expertise in research and education, they share the common mission of studying the applications of information through the three key research thrusts of life sciences, communication, and knowledge management.

The Center also propels its strategic initiatives through international partnerships, which now include four formal partnerships with LINCS, Paris; ETH, Zurich; EAFIT, Columbia; and HIIT, Helsinki. Together, CSoI and its international partners engage in research, education, and diversity efforts that enhance CSoI's outreach and promote its contributions to the broader public and scientific community.

CSoI's educational goals are also echoed through programmatic initiatives that introduce undergraduate students to the core theoretical principles and applications of information science, encourage graduate students to collaborate in interdisciplinary projects, and offer funding to postdoctoral researchers at affiliated institutions. With respect to diversity, CSoI focuses on enhancing the participation of women and minorities in various disciplines associated with its scope. The combination of CSoI's research, education, and diversity missions contribute significantly to the reach and representation of the emerging information science field.

CSoI Highlights of 2015 included:

Renewed by NSF in 2015 for another $25 million

Secured over $1 million in industry-funded projects

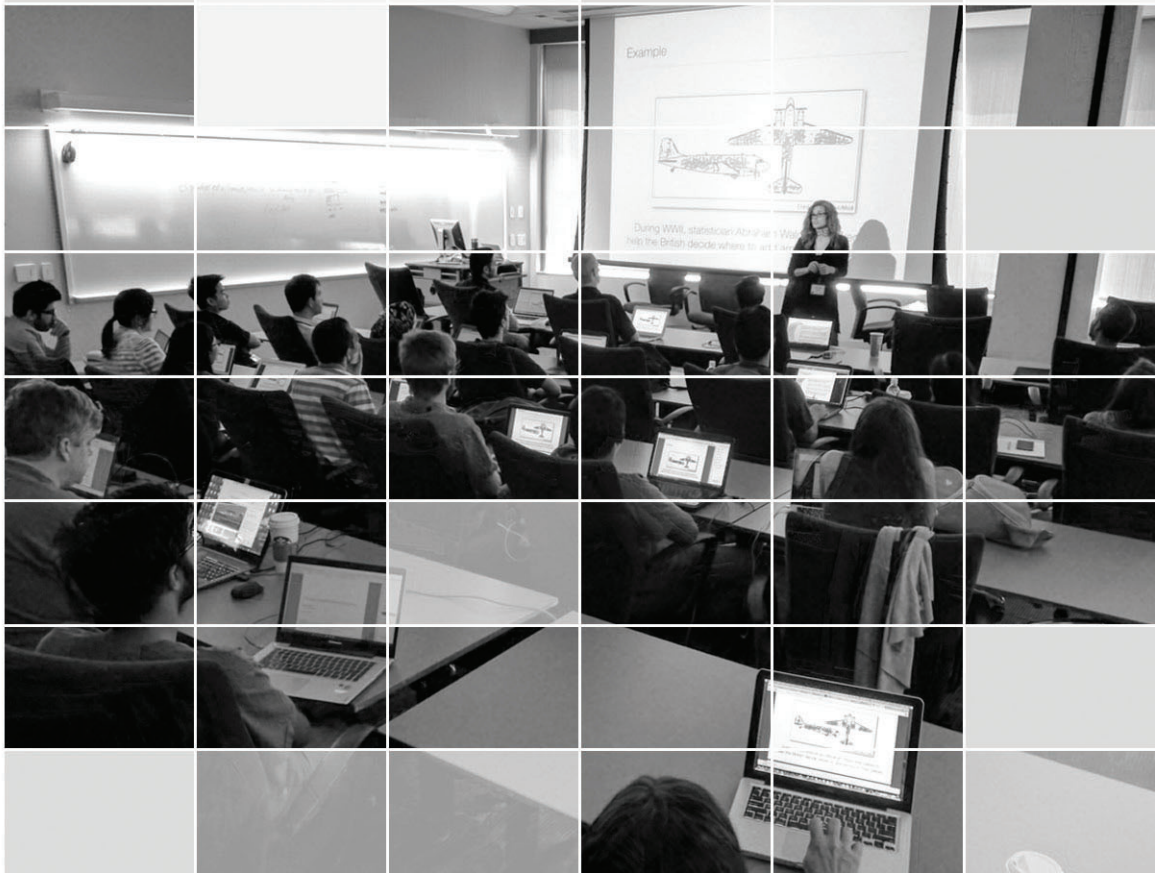
Facilitated a large number of personal exchanges and international partnerships

Increased representation of U.S. citizens and permanent residents, women, and other underrepresented groups in the field of information science

Expanded our undergraduate research and mentoring programs through a workshop that introduced data analysis, community-building, and diversity awareness to students

Created activities that increase students' professional and technical capacities and added significant value to their departmental experience

Coordinated new classroom-based and online courses and modules related to our theme of data to information to knowledge



ADVANCING

THE NEXT GENERATION OF INFORMATION THEORY ... AS FAST AS HE CAN

Spend five minutes with **Wojciech Szpankowski**, the Saul Rosen Professor of Computer Science, and you'll realize quickly that he isn't a man who lets grass grow under his feet. In fact, grass seed doesn't stand a chance of geminating if it falls on the path of a man whose feet move as fast (if not faster) than his mind.

Known to everyone as Wojtek (pronounced Voy Tek), his career of contributions spans more than 35 years and includes many collaborative and multi-disciplinary efforts both on and off campus. He is the current director of the Center for Science of Information, working to advance the next generation of information theory through collaborative research and teaching. This 10-year, $50 million National Science Foundation (NSF) grant entitled "Emerging Frontiers of Science of Information" is the first NSF-funded Science and Technology Center in Indiana.

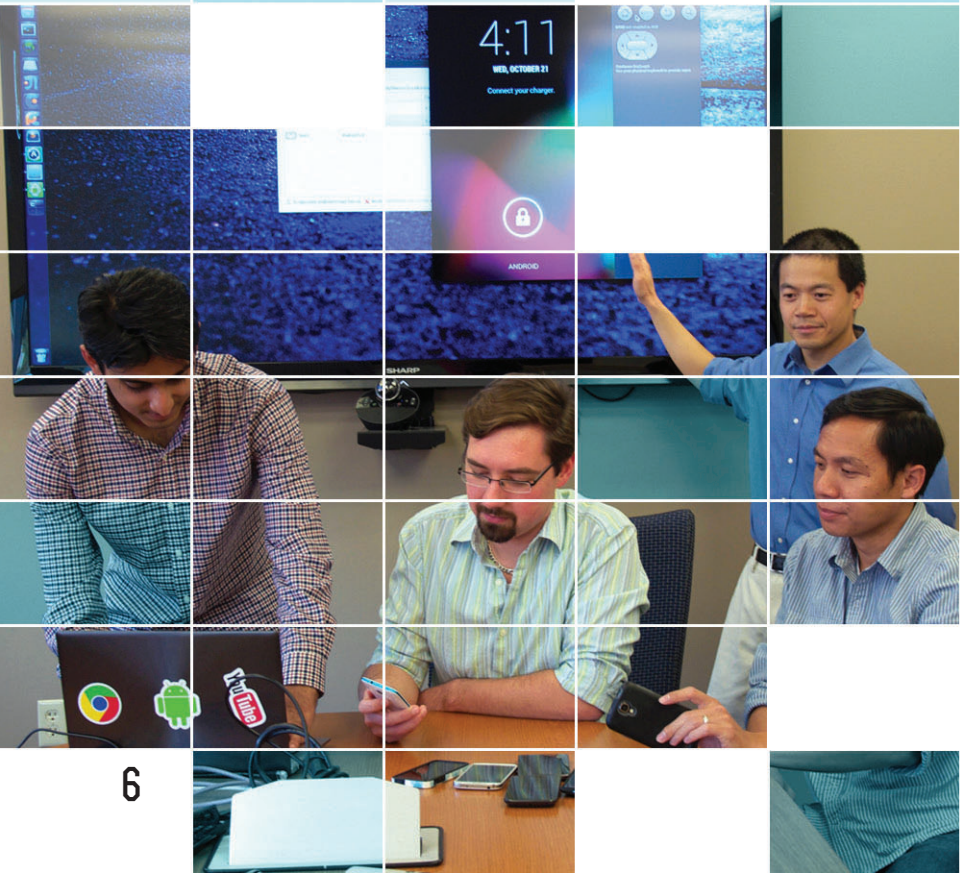
Wojtek's accolades this past year have been nothing short of impressive. He was presented with the inaugural 2015 Arden L. Bement Award, one of Purdue's top three awards for research. Months later, he was named Distinguished Professor of Computer Science by the Purdue Board of Trustees.

His other accomplishments include the 2010 Alexander von Humboldt Research Award and being a Humboldt Fellow, Fellow of the IEEE, and Erskine Fellow at the University of Canterbury. Wojtek has served on top editorial boards and gave the Helsinki Distinguished Lecture Series on Future Information Technology in 2014. He also wrote Average Case Analysis of Algorithms on Sequences and co-authored Analytic Pattern Matching: From DNA to Twitter with Philippe Jacquet. Before coming to Purdue, Wojtek was an assistant professor of electrical engineering at Technical University in Gdansk, Poland, from 1980-83, and was an assistant professor of computer science from 1983-84 at McGill University in Montreal.

Mike Attwel, *Contributing Photographer*

PROFESSORS XU, ZHANG AND RESEARCH ASSISTANTS

RECOGNIZED FOR CYBER SECURITY AND FORENSICS RESEARCH



It's been a good year for the Professors Dongyan Xu and Xiangyu Zhang and their stellar research assistants in the CS Department.

This past fall, they were recognized at the top-tier, 22nd ACM Conference on Computer and Communications Security (CCS'15) for their paper, "GUITAR: Piecing Together Android App GUIs from Memory Images," co-authored with Ph.D. students Brendan Saltaformaggio, Rohit Bhatia, and Zhongshu Gu (now with IBM Research). This award was presented at the conference in Denver, and is one of only three papers sharing the award from the 128 papers accepted out of 646 submissions. The paper describes the new memory forensics tool, GUITAR, which allows cyber crime investigators to recover the graphical user interface (GUI) of Android apps frozen in a device's memory snapshot.

To provide a little background, it's important to note that the internals of Android app GUIs are notoriously complex. Even worse, the Android system will intentionally destroy many GUI components when each app is backgrounded (replaced on the device's screen by a new app). These challenges have made it impossible for previous memory forensics tools to be able to recover full GUIs. The exciting aspect of GUITAR, is that it is able to overcome the challenges of in-memory GUI recovery using program analysis and creative "puzzle piecing" techniques. Using GUITAR, an investigator can recover the GUIs of any apps in a memory image of any Android device. Their work was supported in part by the National Science Foundation (NSF) under a SaTC Medium award.

Another of their significant research contributions include the work described in their paper titled "ProTracer: Towards Practical Provenance Tracing by Alternating Between Logging and Tainting", which was co-authored with Ph.D. student Shiqing Ma. This paper was recognized at the Network and Distributed System Security Symposium 2016 (NDSS'16) – one of only four papers receiving the Distinguished Paper Award from the 60 papers accepted from 389 submissions. The paper presents a new provenance tracing system called ProTracer, which collects lineage of system data at the operating system (OS) level, and enables system administrators and attack investigators to understand the root cause of an advanced persistent threat (APT) attack, which may have occurred long ago, or determine the ramifications of the APT attack for possible recovery.

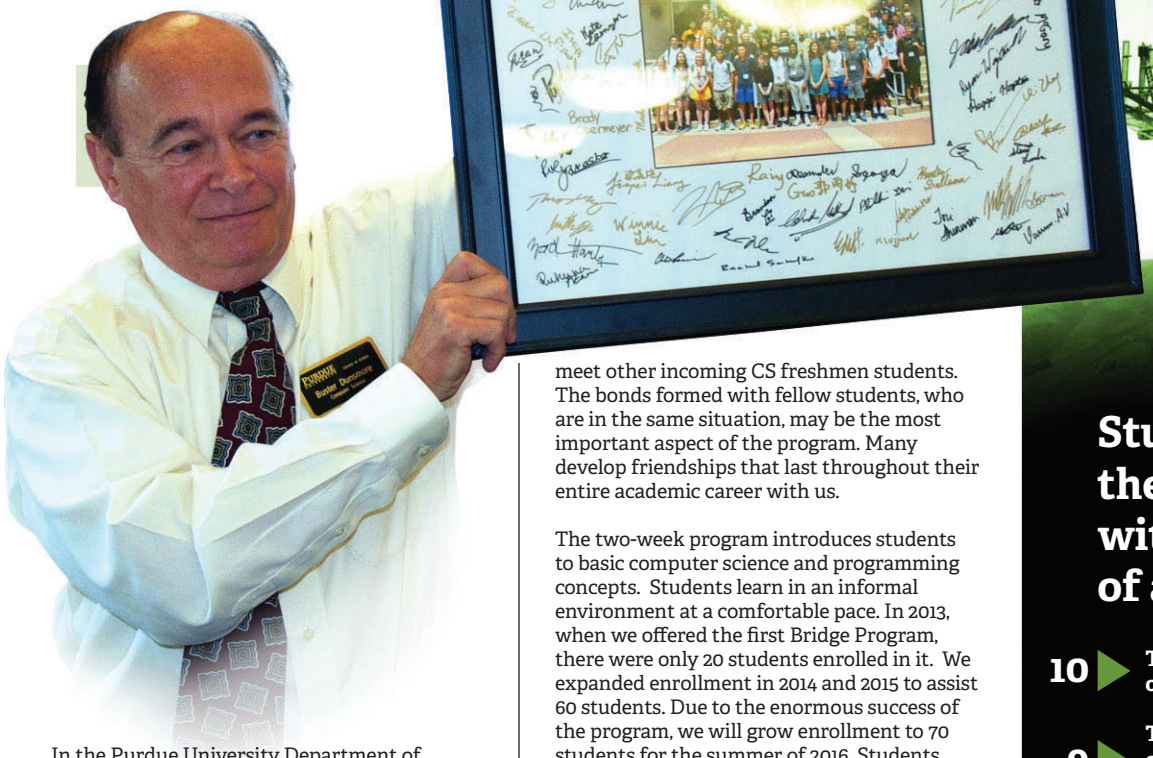
Traditional provenance tracing approaches suffer from many problems including but not limited to high run-time overhead, high storage overhead, and the "dependency explosion" problem for log analytics. ProTracer re-designs the OS-level audit tracing architecture, leverages cutting-edge program analysis methods, and employs a novel online event processing mechanism. Particularly, by performing system-level and in an alternating fashion, ProTracer overcomes the limitations of logging and tainting techniques (when applied alone) while leveraging their respective advantages.

Zhang, Xu, and their students' work in APT attack prevention, detection, forensics, and recovery has been supported in part by the Defense Advanced Research Projects Agency (DRAPA), National Science Foundation (NSF), Office of Naval Research (ONR), and Cisco Systems. They are part of DARPA's Transparent Computing Program, which aims at making system/network component operations and interactions more transparent for better defense against advanced, stealthy cyberattacks such as APTs.

As an added boost for the team, Prof. Xu was recognized this spring with the College of Science's Research Award for both his individual and collaborative achievements with his colleagues.

BUILDING A BRIDGE TO SUCCESS

By Professor H.E. (Buster) Dunsmore



In the Purdue University Department of Computer Science, we have found that students who are comfortable in the first computer science course and who do well in it, usually do well in all their other CS courses and earn their bachelor's degree in CS. On the other hand, those students who are not comfortable and do not do well in their first computer science course, frequently have difficulty in other courses and often drop out without earning our degree.

In the summer of 2013, we launched the Bridge Program to benefit students with good math scores, good high school GPAs, good SAT scores, but with little or no programming experience. The program was created to ensure that all students – with varying levels of experience – have a level playing field and an equal opportunity to succeed in the first CS course. Students arrive at our department with a wide range of backgrounds. On one extreme, we have incoming freshmen with years of experience in programming. At the other extreme, we have incoming freshmen who have never done any programming. The latter group of students often do poorly in the first CS class (CS 18000). Many feel concerned, and even lost, because their fellow students can "speak Java" from the first day of class. Many of these students underestimate their ability to succeed as a CS major and self-select out of CS after the first or second semester. But, we were hopeful that these students could be successful given a little boost or a bridge. The program also gives students an opportunity to meet other incoming CS freshmen students. The bonds formed with fellow students, who are in the same situation, may be the most important aspect of the program. Many develop friendships that last throughout their entire academic career with us.

The two-week program introduces students to basic computer science and programming concepts. Students learn in an informal environment at a comfortable pace. In 2013, when we offered the first Bridge Program, there were only 20 students enrolled in it. We expanded enrollment in 2014 and 2015 to assist 60 students. Due to the enormous success of the program, we will grow enrollment to 70 students for the summer of 2016. Students come to campus to participate in the program during the first two weeks in August, just before fall semester begins. Each day (Monday-Friday), the students have one hour of traditional instruction in the morning and afternoon, and two hours of lab each morning and afternoon with self-paced exercises that include ample help from lab instructors. The student-to-lab instructor rate is about 1-to-5, ensuring plenty of personal attention. In 2014 and 2015, several lab instructors were former Bridge students, giving back to the program that helped them get started in computer science. Bridge Class topics include Computing Basics, Types, Variables, Strings, Selection, Repetition, Arrays, Simple Graphical User Interfaces, Classes, Objects, Methods, and Inheritance. The students have a "final exam" on the last Friday morning.

The retention rate after one year for Bridge students has been approximately 80%, even better than the 75% retention rate for non-Bridge students. Many of these students are not just surviving, but thriving! They have been chosen as officers in student organizations, have been recognized for academic honors, have received internships, have received scholarships, and have been chosen as Undergraduate Teaching Assistants (UTAs). The 2015 Bridge Class results are similar to what has happened each year. A remarkable 82% of the students succeeded in CS 18000 with a C or better, which is required to continue to other CS courses.

Students finish the Bridge Program with a "Top 10" list of achievements:

10. **They have learned a large number of computer science concepts.**
9. **They have experience with classes like those they encounter in college.**
8. **They have experience with labs and know how we conduct them.**
7. **They have the experience of taking a "final exam".**
6. **They have met and built relationships with several members of their incoming class.**
5. **They are familiar with students who will be their lab instructors and mentors.**
4. **They have networked with prior Bridge students.**
3. **They have explored the campus and CS building early, and know their way around.**
2. **They have formed friendships that will last during their time at Purdue, and beyond.**
1. **Most importantly – they are now confident that they can succeed!**

REACHING OUT FOR COMPUTER SCIENCE

By Phil Sands, K-12 Outreach Coordinator

The Computer Science Department's K-12 Outreach program is committed to improving access to high quality computer science education for Indiana students, educators and communities. The focus of the program is to assist Indiana teachers and students in a variety of ways. For teachers, the aim is to help support classroom instruction and the development of healthy and sustainable computer science programs. This can be done through professional development opportunities and work with the Indiana Hoosier Heartland chapter of the CSTA. For students, the focus is on engagement opportunities. The Outreach program works with students both on-site and on Purdue's campus in order to increase the effectiveness and reach of their efforts.

One of the key areas of focus for the Outreach program is to encourage underrepresented minority groups within the field of computer science. For too long, computer science has been viewed as a discipline for students from a limited subset of backgrounds and experience levels. In order to effect change in this area, K-12 Outreach developed the Mentors for Aspiring Girls in Computing (MAGIC) program to mentor current high school aged women in STEM and technology related career pathways. Through the work of our undergraduate women, the program aims to develop interest in computing and inspire students to look at college programs in computer science.

For the past 20 years, Purdue CS has offered a unique summer camp experience for middle school and high school students. This program provides an introductory computer science experience for students at a time when it may make a significant impact on their future interests. The students learn to program, develop web applications, understand embedded systems, and look at special topics in computing. These high school camp themes include security, big data, and web application development.

Online course for HS students

Outreach is now running an Advanced Placement Computer Science course designed for high school students. The course will be hosted on the massive online open courseware platform, edX, and will be available to any high school student in the world. This course will feature support from computer science faculty and students and should reach as many as 5,000 students in its first year.

SPOTLIGHT ON DIVERSITY

CS WOMEN LEAVE GRACE HOPPER INSPIRED, READY TO LEAD

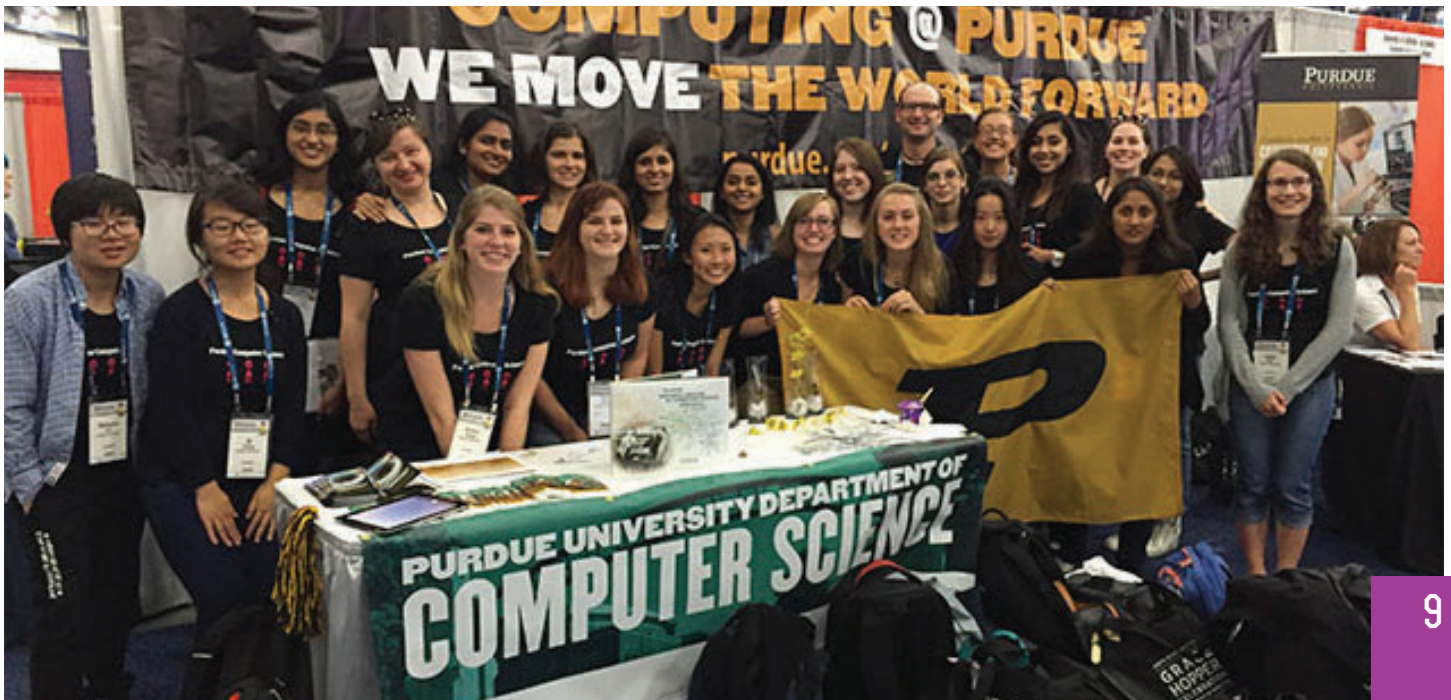
For the past 10 years, the CS department has been ushering bright young women to the Grace Hopper Convention (GHC) – the world's largest gathering of female computer scientists and technologists.

This year, a record number of 35 female students from the department answered the call and attended the conference in Houston, Texas, which was aptly titled OurTimeToLead. The turnout just keeps ballooning for this major event, with more than 12 thousand women in tow, marking an increase of 10 thousand participants in just five years. Yes, that's 10 THOUSAND WOMEN – a healthy sign efforts are working to bring more women to the rapidly growing field of CS.

CS women were treated to numerous workshops, panels, and significant guest speakers, including Hilary Mason, the founder of Fast Forward Labs and an active member of New York Mayor Bloomberg's Technology and Innovation Advisory Council. As an added bonus, nine women from Purdue CS walked away with scholarships to assist their educational efforts. Renate Mallus-Madot, graduate office coordinator, and Scott Nelson, administrator of undergraduate programming and services, accompanied the women to the event. They were honored and excited to see two of our CS students win major scholarships. Bridgette Kuhn, a junior in computer science, was presented with the Microsoft Scholarship, and Eehita Parameswaran was awarded the Anita Borg Scholarship. Additionally, seven more undergraduates won scholarships from Apple, including Guthami Kamalnath, He Huang, Misha Malik, Janka Gal, Rashmi Iyer, Qi Zhang, and Kaley Bean.

Graduate students Pinar Yanardag and Ilke Demir presented at the conference, while Yanardag noted that this year marks her fifth trip to GHC, which is always an inspiration for her. "I was thrilled to attend the conference as one of the 10 Twitter Women Fellows, a fellowship that includes a four-day, pre-conference event in Houston with Twitter engineers," she said. During the conference, Pinar was fortunate to meet with NASA astronaut Cady Coleman, a veteran of three space missions, as well as U.S. Chief Technology Officer Megan Smith, who serves President Obama's administration. Yanardag created a project (with another PhD student) that requires them to interview female computer scientists, so they can gain insight and create networking opportunities. "I was fortunate to interview with Megan Smith about the role of Data Science in the Obama administration for our upcoming "Women in Data Science" series," Pinar added.

Founded in 1994, GHC showcases research and career interests of women in computing, while also providing a venue for academic institutions and corporations to recruit. Anita Borg and Telle Whitney created the conference to celebrate the legacy of Admiral Grace Murray Hopper, an unsung female hero of technology. Hopper was one of the first programmers of the Harvard Mark 1, and in 1952 invented the first compiler, which is a software that translates programming language into numbers a computer understands.



NEW FACULTY

Growing, growing, getting stronger . . .

The CS Department proudly welcomes seven outstanding new professors to the faculty family for the 2015-2016 academic year. Five of the faculty began in the Fall of 2015, including Elias Bareinboim, Aniket Kate, Bruno Ribeiro, Hemanta Maji, and Jean Honorio. Jeremiah Blocki and Petrow Drineas will join the Department this coming fall.

The new faculty members are part of an overall departmental growth, which will result in an expansion of nearly 30% before conclusion. The expansion, titled "Strengthening Computer Science", is supported by Purdue President Mitch Daniels and is part of his Purdue Moves initiative, which sets forth to assist the growth of the University's STEM areas believed to have the greatest potential to change the world.

Here's a little bit about our faculty . . .

Elias Bareinboim earned his PhD from the Computer Science Department at the University of California, Los Angeles, working with Judea Pearl. His interests are in causal and counterfactual inferences and their applications. He is also broadly interested in artifcial intelligence, machine learning, robotics, and philosophy of science. His doctoral thesis provides the first general framework for solving the generalizability problems in causal inference, which has applications across all the empirical sciences. This winter, Elias was named to AI's 10 to Watch – a prestigious list of young stars in the field compiled by the Institute of Electrical and Electronics (IEEE).

His recognitions also include the Dan David Prize Scholarship, the Yahoo! Key Scientific Challenges Award, the Outstanding Paper Award at the 2014 Annual Conference of the American Association for Artificial Intelligence (AAAI), and the Edward K. Rice Outstanding Graduate Student.

Aniket Kate was a junior faculty member at Saarland University in Germany, where he led the Cryptographic Systems Research Group within the Cluster of Excellence. Prior to joining Saarland, he was a postdoctoral researcher at Max Planck Institute for Software Systems (MPI-SWS), Germany. He earned his PhD from the University of Waterloo, Canada in 2010 and his master's degree from Indian Institute of Technology (IIT) - Bombay, India in 2006. He is an applied cryptographer and a privacy researcher, and his research interests lie at the intersection of cryptography, and systems security research.

Bruno Ribeiro conducted his postdoc research at Carnegie Mellon and at the University of Massachusetts, Amherst (UMASS). He earned his PhD from UMASS in 2010 and his M.Eng. and B.Sc. in computing from the Federal University of Rio de Janeiro. His central research interest is in big data and data science, particularly in the measurement, analysis, and forecasting of complex large-scale social and technological networks. During his first in the Department, he won the ACM SIGMETRICS 2016 Best Paper Award for his work titled "On the Duration and Intensity of Competitions in Nonlinear Polya Urn Processes with Fitness." Last spring, he was an invited speaker at the ICWSM Workshop for Modeling and Mining Temporal Interactions, and a keynote speaker at the 7th Annual Workshop On Simplifying Complex Networks for Practitioners SIMPLEX'15 at WWW in Florence, Italy.

Hemanta Maji conducted his postdoc research at the Department of Computer Science at the University of California, Los Angeles & Center for Encrypted Functionalities. He earned his PhD from the University of Illinois, Urbana-Champaign and his B-Tech from the Indian Institute of Technology in Kanpur. Hemanta received the Computing Innovation Fellow sponsored by the Computing Research Association in 2011 and 2012 and was a Center Fellow at the Center for Encrypted Functionalities in 2013 and 2014. His interests include Cryptography and Algorithms with special emphasis on Secure Computation and Information-theoretic Cryptography.

Jean Honorio previously worked as a postdoc associate for the Computer Science and Artificial Intelligence Lab at the Massachusetts Institute of Technology (MIT). He earned his PhD in computer science from Stony Brook University in New York and his MSc in computer science from George Washington University, Washington DC. In addition, he earned his MBA from the Universidad del Pací co, Lima, Peru as well as his BSc in Systems Engineering. His research focuses on developing computationally and statistically efficient algorithms, understanding their behavior using concepts such as convergence, sample complexity, and privacy, and designing new modeling paradigms such as models rooted in game theory.

2016 Fall Faculty

Jeremiah Blocki arrives this fall, leaving his postdoc research at Carnegie Mellon University where he was supported by a NSF Graduate Research Fellowship. He also completed his undergraduate studies there, earning a double major in computer science and mathematics. Jeremiah is a theoretical computer scientist who applies fundamental ideas from computer science to address practical problems in usable privacy and security. His research interests include developing usable authentication protocols for humans.

Petros Drineas also joins the CS faculty this fall as an associate professor. He previously worked as a visiting professor at Sandia National Laboratories. Additionally, he was a visiting fellow at the Institute for Pure and Applied Mathematics at the University of California Los Angeles in 2007, a long-term visitor at the Simons Institute for Theoretical Computer Science at the University of California Berkeley in 2013, and a collaborator with industrial research labs that included Yahoo and Microsoft. Petros also was the program director for the Computer and Information Science and Engineering directorate (CISE) at the National Science Foundation (NSF) from Oct. 2010 – Dec. 2011. His research interests include the design and analysis of randomized algorithms for numerical linear algebra problems, as well as their applications to the analysis of modern, massive datasets.

Read more about our talented new faculty; click on the bio option for more information:
https://www.cs.purdue.edu/people/faculty/index.html

Computational Science and Engineering

Computational science and engineering, or scientific computing, provided the impetus for many of the early computer science departments in the 1960s. Purdue is one of the few programs nationwide that have consistently maintained a leadership position in this important discipline. The computational science and engineering group includes nine full-time faculty members (one with a joint appointment in Mathematics). The group's research activity focuses on the development of algorithms (numerical as well as combinatorial), parallel and distributed techniques, software infrastructure, and novel computing platforms. These research efforts are driven by state-of-the-art applications in modeling of materials and bio-chemical processes (ranging from atomistic to systems-level models), novel micro-electromechanical systems, structural mechanics and control, robotics and advanced manufacturing, image processing and visualization (with applications in life sciences and health care), and critical infrastructure protection like power grids and civil infrastructures.

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David Gleich

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Andreas Wilke, Jared Bischof, Wolfgang Gerlach, Elizabeth M. Glass, Travis Harrison, Kevin P. Keegan, Tobias Paczian, William L. Trimble, Saurabh Bagchi, Ananth Grama, Somali Chaterji, Folker Meyer: *The MG-RAST metagenomics database and portal in 2015.* Nucleic Acids Research 44(Database-Issue): 590-594 (2016)

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Andreas Wilke, Jared Bischof, Wolfgang Gerlach, Elizabeth M. Glass, Travis Harrison, Kevin P. Keegan, Tobias Paczian, William L. Trimble, Saurabh Bagchi, Ananth Grama, Somali Chaterji, Folker Meyer: *The MG-RAST metagenomics database and portal in 2015.* Nucleic Acids Research 44(Database-Issue): 590-594 (2016).

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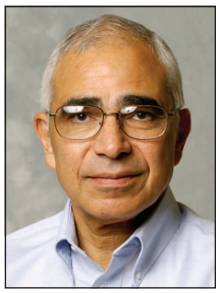

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Robert Skeel

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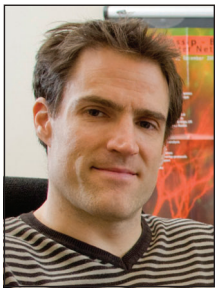
Programming Languages and Compilers

The programming languages and compilers group at Purdue engages in research spanning all aspects of software systems design, analysis, and implementation. Our faculty have active research projects in functional and object-oriented programming languages, both static and dynamic compilation techniques for scalable multicore systems, scripting languages, distributed programming abstractions and implementations, real time and embedded systems, mobile and untrusted computing environments, and runtime systems with special focus on memory management and parallel computing environments. Growing areas include generative programming, assured program generation, and the application of programming languages to fields such as databases, machine learning, and hardware architecture.

SELECTED PUBLICATIONS

Patrick Eugster



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Antony Hosking

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Zhiyuan Li

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Tiark Rompf

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Databases and Data Mining

The Databases and Data Mining group conducts fundamental and cutting-edge research in database systems, database privacy and security, data mining, web search, information retrieval, and natural language processing. A vast array of projects and topics, this area's research covers database management systems, cyber infrastructure, data and service integration and schema matching, data quality, database security and online auctions, massively parallel spatiotemporal data management, privacy enhancing technologies for data, text, and data mining, private and secure data dissemination, scientific data management, search and intelligent tutoring, self-learning disk scheduling, statistical relational models, stream data management, uncertainty data management, and trustworthy data from untrusted servers. Members of the group engage in high-impact multidisciplinary projects and collaborations that involve multiple disciplines, including Agronomy, Biology, Chemistry, Chemical Engineering, Linguistics, Nursing, Physics, and Social Sciences.

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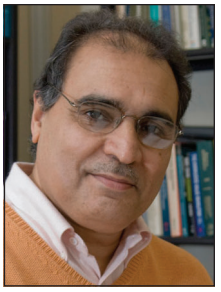

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Sunil Prabhakar

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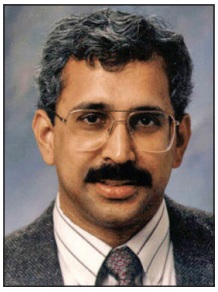
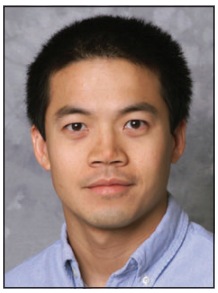
Vernon Rego



Dongyan Xu



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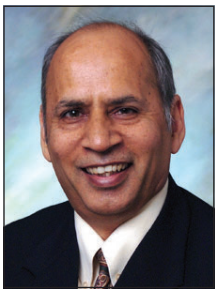
Distributed Systems

The distributed systems group focuses on designing distributed systems that are scalable, dependable, and secure, behaving according to their specification in spite of errors, misconfigurations, or being subjected to attacks. Areas of focus include virtualization technologies with emphasis on developing advanced virtualization technologies for computer malware defense and cloud computing. Researchers at the Lab for Research In Emerging Network & Distributed Systems (FRIENDS) have been studying the security, reliability, and performance of virtual machines and virtual infrastructures in cloud computing environments. Ongoing research efforts in the computer malware defense area include operating system level information flow tracking for user-level malware investigation, virtual machine (VM) introspection for stealthy malware monitoring and detection, and VM memory shadowing for kernel-rootkit prevention and profiling. In the virtual distributed computing area, the lab has proposed and instantiated the concept of "virtual networked environment" for creating virtual infrastructures on top of a shared physical hosting infrastructure. Researchers at the RAID laboratory are conducting scientific research in a variety of subjects related to experimental analysis such as: communication experiments for distributed applications, network communication measurement experiments, experimental analysis of communication infrastructure, adaptability experiments for distributed systems, replication and recovery experiments for distributed database systems, concurrent check-pointing and rollback-recovery algorithms, concurrency control for distributed database systems, efficient implementation techniques for distributed systems, digital library, and mobile communication.

SELECTED PUBLICATIONS

H.E. (Buster) Dunsmore

Aditya Mathur



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Software Engineering

The software engineering area conducts research on applying advanced program analyses towards problems related to fault isolation and various kinds of bug detection, including those related to race conditions in concurrent programs, and specification inference for large-scale software systems. Aspect-oriented abstractions and new program slicing and mining techniques are some of the mechanisms that are being explored to address these issues.

Graphics and Visualization

The overall area performs research in graphics, visualization, computational geometry, and related applications. Major project areas for the researchers include **Model Acquisition**, **Image Generalization**, **Scientific Visualization**, **Urban Modeling**, **Robust Computational Geometry**, and **Geometric Computations and Constraints**. Some of the most notable research contributions from the groups include those from the **Model Acquisition** group, who collaborated with Purdue's civil engineers to produce a high-fidelity simulation of the 9/11 attacks on the World Trade Center. The visualization of the occurrence is relevant to users outside of computer science and civil engineering, and has been downloaded more than 10 million times. Researchers in the **Image Generalization** group convey information in cases like 3-D scene exploration, remote visualization, acceleration of high-cost rendering effects, and video surveillance. Images are computed by sampling data with rays defined by a camera model, mostly by using the planar pinhole camera model, which suffers from important limitations. Those who work in **Scientific Visualization** create computer simulations and high-throughput measuring devices that produce an overwhelming volume of data across science, engineering, and medicine. This group explores topics in visualization and geometric data processing to devise new models and efficient algorithms for the effective visual mapping and analysis of information. Researchers in **Urban Modeling** work on the modeling and simulation of large urban environments. The goal is to obtain digital models of large-scale urban structures in order to simulate physical phenomena like changes in weather, vegetation, and human activities in relationship to population and employment changes. Computational geometry algorithms are formulated in a model where arithmetic operations have infinite accuracy and unit cost for researchers in the area of **Robust Computational Geometry**. Members of this group have developed robust versions of five core algorithms and validated them on examples that surpass results of prior research. **Geometric Computations and Constraints** is a research area that complements computational geometry, whereby computations on nonlinear geometric structures are developed and analyzed. New techniques for solving geometric constraint problems and including into the vocabulary curves and surfaces from CAGD are of particular interest to the group.

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Christoph Hoffmann

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Voicu Popescu

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Information Security and Assurance

The Computer Science Department has almost a third of its faculty who do either their primary work on security topics, or have some application of security to their work in other disciplinary areas. Significant research areas include **Cryptography** – ciphers, secure computation, anonymity, usability; **Data security and privacy** – privacy preserving data mining, assurance of outsourced data, access control, and trust negotiation; **Network and Systems security** – security of distributed systems, policy verification, sensor networks, protocols, virtual machines, and test beds; **Software security** – malware analysis, verified software development; and **Intrusion detection, investigation and response** - runtime anomaly detection, and system integrity and defense. Information security research at Purdue traces its beginnings back to the 1970's. Early intrusion detection, malware analysis, and prevention work began in the late 1980's. Work in these and other traditional computer science areas grew increasingly multidisciplinary through the 1990's and led to the establishment of CERIAS, the well-recognized education and research center which draws faculty from almost 20 different academic disciplines.

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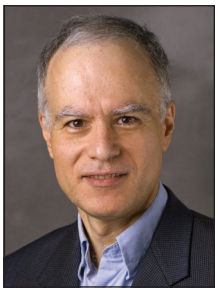
Mikhail Atallah



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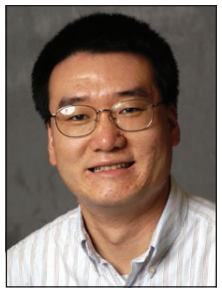
Ninghui Li



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Samuel Wagstaff

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Networking and Operating Systems

Faculty in the area of networking and operating systems tackle fundamental problems at different layers of the network protocol stack—from the medium access control layer all the way up to the application layer. This group uses theoretical models, simulation, emulation, and extensive testbed experimentation to develop and evaluate their proposed solutions. Their research has leveraged techniques from game theory, information theory, complexity theory, optimization, and cryptography in their solutions. Their methods have been implemented on a variety of platforms, ranging from large clusters to network processors and resource-constrained wireless sensor motes. Numerous projects undertaken by members of the group include fault localization in enterprise networks, packet classification and scheduling in Internet routers, scalable Internet measurement, Internet routing policy analysis, secure and scalable media streaming over the Internet, secure network coding in wireless mesh networks, design of defenses against malware and denial of service attacks, scalable network simulation and emulation, and coverage - localization and data fusion in energy-constrained wireless sensor networks.

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Doug Comer

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Sonia Fahmy

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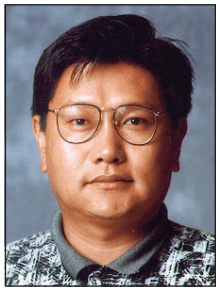
Kihong Park



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Mathias Payer

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Machine Learning and Information Retrieval

With massive data available from various engineering, scientific, and social disciplines, machine learning and information retrieval have played an imperative role in discovering hidden patterns or relationships between intertwined components (people, web pages, or genes, in a complex system), understanding properties of various systems, and making meaningful predictions for a variety of applications. This growing group has efforts that include solving multiple problems in relational modeling, like fusion and analysis of multi-source relational data, and also modeling relational communication on distributed team effectiveness. This area integrates machine learning methods with agent-based models to form a compositional model that combines components that are learned from data with components that are hand-engineered using traditional methods. This combination produces powerful tools for understanding the emergent behavior of complex social and organizational systems. Research in this area develops federated text search, which is the search beyond traditional engines such as Google, Yahoo! or MSN by finding information that is "hidden" behind many search engines, using cutting-edge computer science techniques to construct an exploratory, but fully functioning differentiated instructional system of mathematical word problem solving. Additional research addresses problems in privacy-preserving data mining by developing technology that shares information to calculate correct results, where the shared information can be shown not to disclose private data. Another research focus develops new methods to detect context sensitive modules for complex biological and social networks. This group combines statistical learning with ab-inito methods for computational materials design, and designs Bayesian matrix factorization methods for collaborative filtering (with applications to online recommendation systems) and text clustering.

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Jean Honorio

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Jennifer Neville

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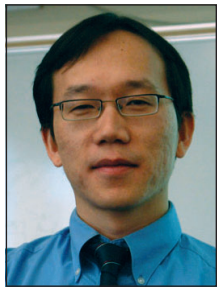

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Luo Si

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Lei Cen, Christopher S. Gates, Luo Si and Ninghui Li. *(2015) A Probabilistic Discriminative Model for Android Malware Detection with Decompiled Source Code.* IEEE Trans. Dependable Sec. Comput. 12(4): 400-412, 2015. (12 Pages).

Theory of Computing and Algorithms Research

Members of the Theory of Computing and Algorithms group work in a wide variety of research areas. These include analysis of algorithms, parallel computation, computational algebra and geometry, computational complexity theory, digital watermarking, data structures, graph algorithms, network algorithms, distributed computation, information theory, analytic combinatorics, random structures, external memory algorithms, and approximation algorithms. The ongoing research includes theoretical improvements on applied problems, and algorithms with immediate potential for application. The group has made notable contributions on topics such as updating minimum spanning trees, shortest paths in planar graphs, computing approximate minimum spanning trees distributively, low-diameter P2P networks, parallel computational geometry, cascading divide and conquer, query indexing and velocity constrained indexing, external memory graph algorithms, compressed suffix arrays, and the analysis of Lempel-Ziv codes. This group also provides leadership to the Center for the Science of Information – an NSF sponsored Science and Technology Center (STC).

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Saugata Basu

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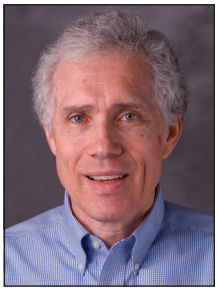
Greg Frederickson



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Susanne Hambrusch

Steve Cooper, Jeff Forbes, Armando Fox, Susanne E. Hambrusch, Andrew Ko, Beth Simon: *The Importance of Computing Education Research.* CoRR abs/1604.03446 (2016).

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Elena Grigorescu

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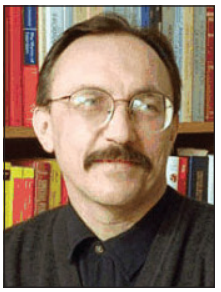
Wojciech Szpankowski



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P. Jacquet and W. Szpankowski, *On the Limiting Distribution of Lempel Ziv'78 Redundancy for Memoryless Sources,* IEEE Trans. Information Theory, 60, 6917-6930, 2014.

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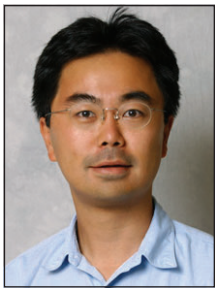
Bioinformatics and Computational Biology

Faculty in the area of bioinformatics and computational biology apply computational methodologies such as databases, machine learning, discrete, probabilistic, and numerical algorithms, and methods of statistical inference to problems in molecular biology, systems biology, structural biology, and molecular biophysics. Bioinformatics and computational biology research enables researchers to process the massive data becoming available with novel experimental methodologies in genomics and proteomics. Current work addressing this need includes the design and implementation of biological databases and text/data mining for life sciences - in particular, automatic gene function annotation from the literature. Advances in molecular biology and systems biology involve the extraction of information and patterns from data. Work in this area includes finding context-sensitive modules from multiple cancer networks, identifying protein-DNA binding sites, analyzing flow cytometry data to find cancer stem cells, algorithms and statistical approaches for functional annotation of molecules based on their sequences, identifying protein biomarkers for lung and prostate cancer using clinical data and experiments with model organisms, and studies of biomolecular networks. Data for these projects are obtained by a variety of experimental technologies, including gene expression microarrays, protein-DNA binding data, flow cytometry data, sequence data, mass spectrometry-based proteomics and metabolomics, and ionomic profiling.

SELECTED PUBLICATIONS

Daisuke Kihara



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REACHING OUT, STRENGTHENING WITHIN

Travel to Tanzania

CS faculty, staff, and students left the West Lafayette campus for a two-week service project at the Matumaini School for Children with Disabilities in Dar es Salaam. Matumaini is a primary school run by the Salvation Army which serves 200 children living with albinism and other disabilities from communities across Tanzania, who would otherwise be at-risk in Tanzanian society. A complete story about this life, changing trip and plans to forge an ongoing relationship with the Matumaini school will be covered in our November newsletter.

The Intersection of Art and Science

The CS Department welcomes a new art exhibit, featuring 10 artists who created pieces that represent the merging of science and emotion. The artworks on display examine the expressions unveiled at the intersection of art, science and technology — a collaboration with the Patti and Rusty Rueff School of Visual and Performing Arts.

DANIEL G. ALIAGA

Daniel G. Aliaga and Devdutta S. Niyogi,
STRONG Cities: Simulation Technologies for the Realization of Next Generation Cities,
National Science Foundation, 01/01/2013-12/31/2015.

Daniel G. Aliaga and Jennifer L. Neville,
HCC: CGV: Medium: Collaborative Research: A Heterogeneous Inference Framework for 3D Modeling and Rendering of Cultural Heritage Sites,
National Science Foundation, 07/15/2013-07/14/2016.

Daniel G. Aliaga, Eric T. Matson, Julia M. Taylor, Haiyan H. Zhang, and Juan P. Wachs,
Collaborative Research: I/UCRC for Robots and Sensors for the Human Well-being,
National Science Foundation, 08/01/2014-07/31/2019.

WALID G. AREF

Walid G. Aref,
Query Processing and Optimization in Spatiotemporal Database Systems,
Umm Al-Qura University, 12/01/2014-11/30/2016.

Eugene H. Spafford, Walid G. Aref, Bharat Bhargava, Chris Clifton, Patrick T. Eugster, and Arif Ghafoor,
Northrop Grumman Option Year 7 funding for CERIAS,
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MIKHAIL J. ATALLAH

Mikhail J. Atallah, Wojciech Szpankowski, Chris Clifton, Ananth Y. Grama, Suresh Jagannathan, Aditya P. Mathur, Jennifer L. Neville, Yuan Qi, Vernon J. Rego, Doraiswami Ramkrishna, Ruben C. Aguilar, Supriyo Datta, Zygmunt Pizlo, and Mark D. Ward,
Emerging Frontiers of Science of Information,
National Science Foundation, 08/01/2010-07/31/2015.

Mikhail J. Atallah, Jitesh H. Panchal, and Karthik Ramani,
CPS: Synergy: Foundations of Cyber-Physical Infrastructure for Creative Design and Making of Cyber-physical Products,
National Science Foundation, 08/15/2013-08/14/2017.

SAUGATA BASU

Saugata Basu,
AF: Small: Algorithmic and Quantitative Semi-algebraic Geometry and Applications,
National Science Foundation, 06/01/2013-05/31/2016.

ELISA BERTINO

Elisa Bertino, Gabriel Ghinita, and Mourad Ouzzani,
TC: Large: Collaborative Research: Privacy-Enhanced Secure Data Provenance,
National Science Foundation, 06/01/2011-05/31/2016.

Elisa Bertino,
Monitoring DBMS Activity for Detecting Data Exfiltration by Insiders,
Northrop Grumman Space Technology, 10/01/2013-09/30/2016.

Elisa Bertino, Stephen J. Elliott, and Kevin J. O'Connor,
Advancing Commercial Participation in the NSTIC Ecosystem,
Daon, 10/01/2013-09/30/2015.

Elisa Bertino,
A Study on Applying White-Box Cryptography to Secure Drone Delivery Services,
Electronics and Telecommunications Research Institute, 07/01/2015-11/30/2015.

Elisa Bertino and Peter N. Baker,
CICI: Data Provenance: Collaborative Research: CY-DIR Cyber-provenance Infrastructure for Sensor-based Data-Intensive Research,
National Science Foundation, 01/01/2016-12/31/2018.

Elisa Bertino,
CICI: Secure Data Architecture: Collaborative Research: AMDN Framework for Secure Scientific Collaboration,
National Science Foundation, 01/01/2016-12/31/2018

Elisa Bertino,
Informatics Database,
Lilly (Eli) And Company, 08/15/2015-05/15/2016.

Elisa Bertino,
Amendment No. 5 "GEPR: Mineral Nutrient Gene Discovery and Gene X Environment Interactions Using the Nested Association Mapping Population in Maize" [Grant 105798],
Donald Danforth Plant Science Center, 8/3/2015.

Elisa Bertino,
Schlumberger Foundation Faculty for the Future Program Fellowship for Shagufta Mehnaz,
Schlumberger Foundation, 08/01/2015-07/31/2016.

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Monitoring DBMS Activity for Detecting Data Exfiltration by Insiders-Change Notice No. 03,
Northrop Grumman Space Technology, 9/18/15.

BHARAT BHARGAVA

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Engineering Security and Performance Aware Vehicular Applications for Safer and Smarter Roads,
Qatar University, 01/01/2015-12/31/2017.

Bharat Bhargava, Eugene H. Spafford, Patrick T. Eugster, Ricardo A. Calix, and Saurabh Bagchi,
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CHRIS CLIFTON

Chris Clifton, Ahmed K Elmagarmid, Mourad Ouzzani, David S. Ebert, Mireille Boutin, William S. Cleveland, Timothy F. Collins, and Edward J. Delp,
VACCINE: Visual Analytics for Command, Control, and Interoperability Environments,
U.S. Department of Homeland Security, 07/01/2009-06/30/2015.

Chris Clifton, Wojciech Szpankowski, Mikhail J. Atallah, Ananth Y. Grama, Suresh Jagannathan, Aditya P. Mathur, Jennifer L. Neville, Yuan Qi, Vernon J. Rego, Doraiswami Ramkrishna, Ruben C. Aguilar, Supriyo Datta, Zygmunt Pizlo, and Mark D. Ward,
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National Science Foundation, 08/01/2010-07/31/2015.

Chris Clifton,
1415 PRF Research Grant,
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Chris Clifton,
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DOUGLAS E. COMER

Douglas E. Comer,
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National Science Foundation, 07/24/2015-01/23/2016.

AHMED K. ELMAGARMID

Ahmed K. Elmagarmid, Chris Clifton, Mourad Ouzzani, David S. Ebert, Mireille Boutin, William S. Cleveland, Timothy F Collins, and Edward J. Delp,
VACCINE: Visual Analytics for Command, Control, and Interoperability Environments,
U.S. Department of Homeland Security,

PATRICK T. EUGSTER

Patrick T. Eugster,
TWC: Small: Practical Assured Big Data Processing in the Cloud,
National Science Foundation, 08/01/2014-07/31/2017.

Eugene H. Spafford, Bharat Bhargava, Patrick T. Eugster, Ricardo A. Calix, and Saurabh Bagchi,
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Patrick T. Eugster,
Hewlett Packard, 3/3/2016.

SONIA A. FAHMY

Sonia A. Fahmy,
NeTS: Small: Meta-Networking Research: Analysis, Partitioning, and Mapping Tools for Large Experiments,
National Science Foundation, 08/01/2013-07/31/2016.

BRUNO RIBEIRO

Bruno Felisberto Martins Ribeiro,
Discovering Network Processes in Time-evolving Networks,
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DAVID F. GLEICH

David F. Gleich,
Career- Modern Numerical Matrix Methods for Network and Graph Computations,
National Science Foundation, 05/01/2012-04/30/2017.

David F. Gleich,
III: Small: Multi-dimensional spectral clustering of multi-way data and networks with tensor eigenvectors,
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Emerging Frontiers of Science of Information,
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David F. Gleich,
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Stanford University, 03/01/2015-05/31/2018.

David F. Gleich, Ananth Y. Grama, and Ahmed H. Sameh,
Fault oblivious computations,
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BIGDATA: F: Models, Algorithms, and Software for Spatial-Relational Networks,
National Science Foundation, 09/01/2015-08/31/2019.

David F. Gleich,
Swept time-space domain decomposition rule for breaking the latency barrier,
Massachusetts Institute of Technology, 09/01/2015-08/31/2018.

David F. Gleich,
Career- Modern Numerical Matrix Methods for Network and Graph Computations,
National Science Foundation, 6/22/2015.

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REU Supplement for NSF-CAREER,
National Science Foundation, 08/24/2015-05/15/2016.

David F. Gleich,
III: SMALL: SPECTRAL CLUSTERING WITH TENSORS,
National Science Foundation, 7/16/2015.

David F. Gleich,
Microsoft Corporation, 6/30/2015

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David F. Gleich, Doraiswami Ramkrishna, and Mark D. Ward,
Emerging Frontiers of Science of Information,
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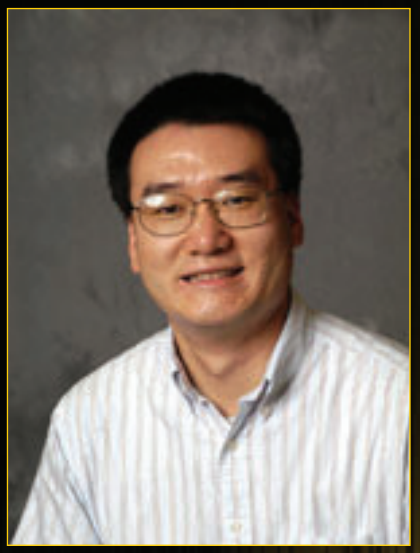
SPOTLIGHT ON RESEARCH

DIFFERENTIALLY PRIVATE DATA PUBLISHING

By Ninghui Li



Data collected by organizations and agencies are a key resource in today's information age. However, the disclosure of those data poses serious threats to individual privacy. Differential Privacy (DP) is a mathematical privacy notion that has been increasingly accepted. An algorithm that satisfies ε-DP guarantees that the output distribution does not change significantly from one dataset to a neighboring dataset, where this change is bounded by a privacy parameter ε. The intuition is that even if one were to exclude one individual's data, in which case that individual's privacy can be considered to be protected, one is likely to publish the same result with a similar probability.

Our research group has studied the relationship between DP and other privacy notions: including the relationship between differential privacy, sampling, and k-anonymization, and a new membership privacy framework that includes DP as well as other relaxations of it as special cases.

Our group has also developed state of the art algorithms for data publishing and analysis while satisfying DP, including techniques for publishing frequent itemsets, publishing histograms for low-dimensional data, publishing summary of a dataset to answer marginal table queries, conducting k-means clustering, and output classifiers using Support Vector Machine, Logistics Regression, and Decision Trees.

Here I give a bit more details on our recent work on publish graph data with DP, which was published in 2016 SIGMOD conference. Graph data (e.g., those from social networking sites) are valuable for research and analysis of social behavior and trends. A major obstacle impeding the release of such data for analysis is the privacy concerns of individuals represented in the datasets. Anonymization methods that simply remove personally identifying information are ineffective. Such methods maintain the original structure of the network and can reveal unwanted information to an adversary. With reasonable background knowledge, an adversary is able to re-identify nodes in the supposedly anonymous graphs.

When applying DP to graph data, there are two variants of DP: in edge-DP, two graphs are neighboring if they differ on a single edge; in node-DP, two graphs are neighboring if by removing one node and all edges incident to the node in one graph, one obtains the other graph. Obviously satisfying node-DP is much harder than satisfying edge-DP, since removing one node may cause the removal of many edges. Because of this reason, most existing approaches that apply DP to graphs consider edge-DP, under the rationale that doing so protects relationship between two entities from being disclosed. However, the privacy offered by edge-DP is much weaker than node-DP, and, is insufficient in most settings.

We developed techniques for publishing the node degree histogram of a graph (which also yields the degree distribution) under node-DP. We introduce a new graph projection method, which uses an edge-addition reconstruction process to transforms a graph so that the maximum degree in the graph is no more than θ. We also prove that publishing the degree histogram after projection has a sensitivity lower than previous approaches, and in this case, publishing a cumulative degree histogram after such a projection has an even lower sensitivity. The lower sensitivities mean that less noise is needed to satisfy DP. We have conducted extensive experiments using 8 real world datasets and found that our proposed mechanisms have significant improvement over previous state-of-the-art approaches. Further research is needed for techniques for publishing other information while protecting privacy.

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Guy Lebanon
Leszek Lilien
Yung-Hsiang Lu
Sanjay Rao
Victor Raskin
Jeffrey Siskind
T N Vijaykumar
Jeff Vitter
Jianlin Xia
David Yau

Faculty Emeriti

Walter Gautschi
Elias Houstis
Robert Lynch
John Rice
John Steele

Visiting Faculty and Research Staff

Pelin Angin
Saleh Basalamah
Lorenzo Bossi
Umesh Bellur
Siarhei Bykau
Somali Chaterji
Lin Chen
Zhumin Chen
Omar Chowdhury
Kalid Hilal
Xi Huang
Yimu Ji
Li Li
Peng Liu
Min Lyu
Despoina Perouli
Min Surp Rhee
Antonino Rullo
Masoud Saeida Ardekani
Weidong Wen
Qian (Kasey) Xiao
Zhaogui Xu
Ulas Yaman
Juan Zhai
Shi Zhang

Instructors

Alan Bunning
Marta Crowe
Bill Crum
Gary McFall
Gustavo Rodriguez-Rivera

Computer Science Staff

Kelly Andronicos
Michael Atwell
Randy Bond
Robert Brown
Ron Castongia
Kelly Cunningham
Jennifer Deno
Susan Deno
Cathy Dyer
Sandra Freeman
Charles Fultz
Vicki Gilbert
Faith Giordano
William J. Gorman
Pam Graf
Christina Harrison
Nick Hirschberg
Jesica Hollinger
Kathy Huseman
Kevin Jones
Brent Ladd
Sally Luzader
Renate Mallus-Medot
Desiree Marmon
Lorenzo Martino
Patricia Morgan
Mike Motuliak
Tammy Muthig
Scott Nelson
Daniel Parrott
Nicole Piegza
Steve Plite
Ashley Quirk
Tomas Ratkus
Phil Sands
Monica Shively
Kiya Smith
Victory Soe
Dan Trinkle

EDUCATION

PHD RECIPIENTS

May 2015

Jian Cui
Visibility Computation through Image Generalization
Advisor: Voicu Popescu
Employer: Google

William Culhane
Optimal "Big Data" Aggregation Systems - From Theory to Practical Application
Advisor: Patrick T. Eugster
Employer: Imperial College London

Alicia Klinvex
Parallel Symmetric Eigenvalue Problem Solvers
Advisor: Ahmed H. Sameh
Employer: Sandia National Laboratories

Wei Peng
On Several Problems Regarding the Application of Opportunistic Proximate Links in Smartphone Networks
Advisors: Xukai Zou, Feng Li, and Ninghui Li
Employer: Intel

Joseph Pfeiffer
Overcoming Uncertainty for Within-Network Relational Machine Learning
Advisor: Jennifer L. Neville
Employer: Microsoft

Naresh Rapolu
Dynamic Re-Optimization Techniques for Stream Processing Engines and Object Stores
Advisor: Ananth Y. Grama
Employer: Google

Philip Ritchey
Synthetic Steganography: Methods for Generating and Detecting Covert Channels in Generated Media
Advisor: Vernon J. Rego
Employer: Texas A&M University

Christine Task
Privacy-Preserving Social Network Analysis
Advisor: Christopher W. Clifton
Employer: Knexus Research Corporation

Qifan Wang
Learning Compact Hashing Codes with Complex Objectives from Multiple Sources for Large Scale Similarity Search
Advisor: Luo Si
Employer: Google

August 2015

Nesreen Ahmed
Scaling Up Network Analysis and Mining: Statistical Sampling, Estimation, and Pattern Discovery
Advisor: Jennifer L. Neville
Employer: Intel Labs

Mohammed Almeshekah
Using Deception to Enhance Security: A Taxonomy, Model and Novel Uses
Advisors: Eugene H. Spafford and Mikhail J. Atallah
Employer: King Saud University

Wei-Chiu Chuang
A Programming Framework to Ease Development of Tightly-Coupled Cloud Applications
Advisors: Dongyan Xu and Charles Killian
Employer: Cloudera

Zhui Deng
Binary Instrumentation and Transformation for Software Security Applications
Advisor: Dongyan Xu
Employer: Google

Zhongshu Gu
Securing Visualized System via Active Protection
Advisor: Dongyan Xu
Employer: T.J. Watson Research Center

Rohit Ranchal
Cross-Domain Data Dissemination and Policy Enforcement
Advisor: Bharat Bhargava
Employer: IBM

Ryan A. Rossi
Improving Relational Machine Learning by Modeling Temporal
Advisor: Sunil Prabhakar
Employer: Palo Alto Research Center

Yao Zhu
Parallel Hybrid Sparse Linear System Solvers with Applications
Advisors: Ahmed H. Sameh and David Gleich
Employer: Bloomberg

December 2015

Ahmed M. Aly
Towards Efficient Processing of Big Spatial Data
Advisor: Walid G. Aref
Employer: Google

Ignacio Garcia Dorado
Smart Cities: Inverse Procedural, Traffic, and Weather for 3D Urban Models
Advisor: Daniel Aliaga
Employer: Google

Md. Endadul Hoque
Ensuring Specification Compliance, Robustness, and Security of Wireless Network Protocols
Advisors: Sonia Fahmy and Cristina Nita-Rotaru
Employer: Northeastern University

Abram Magner
Profiles of PATRICIA Tries
Advisor: Wojciech Szpankowski
Employer: University of Illinois at Urbana-Champaign

Gregory Aaron Wilkin
Efficient Aggregated Deliveries with Strong Guarantees in Event-Based Distributed Systems
Advisor: Patrick T. Eugster
Employer: Rose-Hulman Institute of Technology

Cong Xu
Scheduling and Functionality Offloading
Advisor: Dongyan Xu
Employer: IBM Research

May 2016

Norman (Noor) O. Ahmed
Attack-Resilient Framework for Distributed Systems
Advisor: Bharat Bhargava
Employer: Air Force Research Laboratory

Mehdi Azarmi
End-to-End Security in Service-Oriented Architecture
Advisor: Bharat Bhargava
Employer: EMC

Syed Naqvi
Efficient Sparse Bayesian Learning Using Spike and Slab Priors
Advisor: Yuan (Alan) Qi
Employer: University of Engineering and Technology

Pinar Yanardag
Information Overload in Structured Data
Advisors: Jennifer Neville and Vishwanathan Swaminathan
Employer: MIT Media Lab

GRADUATE
RESEARCH ASSISTANTS

Ahmed Abdelhamid
Amani Abu Jabal
Bara Abusalah
Richa Agarwal
Israa Al-Qassem
Iman Alodah
Balamurugan Anandan
Daniel Andersen
Muhammad Arshad
Jeffrey Avery
Andres Bejarano Posada
Radhika Bhargava
Rohit Bhatia
Priyam Biswas
Alexander Block
Andres Bravo
Xiangyu Bu
Nathan Burow
Nabeel Butt
Lianjie Cao
Yudong Cao
Siyuan Cao
Scott Carr
Sait Celebi
Lei Cen
Keith Chapman
Sze Yiu Chau
Chiahao Chen
Haining Chen
Cheng Cheng
Xin Cheng
Hong Jun Choi
Charles Christoffer
Pranjal Daga
Javad Darivandpour
Debajyoti Das
Wei-Yen Day
Ilke Demir
Ziang Ding
Amr Ebaid
Nicole Eikmeier
Gregory Essertel
Youhan Fang
Venkata Gandikota
Ignacio Garcia Dorado
Huangyi Ge
Asish Ghoshal
Daniel Goldberg
Huyue Gu
Suyash Gupta
Mehmet Gursoy
Christopher Gutierrez
Javid Habibi
Evan Hanau
Benjamin Harsha
Mohamed Hassan

YangYang Hou
Ching-Hsiang Hsu
Jianjun Huang
Min Huang
Syed Rafiul Hussain
Ahmed Mohamed Abd-Elhaffiez Hussein
Kyriakos Ispoglou
Amin Jaber
Sahithya Jagadish
Julian James Stephen
Suhas Raveesh Javagal
Yuseok Jeon
Samuel Jero
Shuxian Jiang
Di Jin
Agrima Jindal
Kristen Johnson
Gowtham Kaki
Xuejiao Kang
Rajas Karandikar
Negin Karisani
Sayali Aniket Kate
Ariful Khan
Ishita Khan
Chung Hwan Kim
Seong Gon Kim
Dohyeong Kim
Chung Hwan Kim
Kyungtae Kim
Taegyu Kim
Kyle Kloster
Akash Kumar
Daniel Kumor
Tatiana Kuznetsova
Yonghwi Kwon
Sudhir Kylasa
Timothy La Fond
Yi-Yu Lai
Duc Le
Wen-Chuan Lee
I-ta Lee
Jihwan Lee
James Lembke
Joseph Lewis
Chang Li
Binhao Lin
Chengyuan Lin
Xuankang Lin
Young-san Lin
Yingqi Liu
Melanie Lotz
Hui Lu
Shiqing Ma
Amgad Madkour
Abram Magner

Ahmed Mahmood
Ajay Mallasandra Sanath
Koray Mancuhan
Easwar Mangipudi
Shamiek Mangipudi
Ganapathy Mani
Caluadewa Dharshaka Mathew
Christopher May
Mary McCall
Derrick McKee
Changping Meng
Danushka Menikkumbura
Shawn Merrill
Daniele Midi
Mohammad Mohsen Minaei Bidgoli
Mohamed Mohamed
Mohamed Abdelrahman Zahran Mohamed
Shahin Mohammadi
John Moore
Pedro Moreno Sanchez
Anand Mudgerikar
Keerthi Raj Nagaraja
Syed Abbas Naqvi
Huda Nassar
Abhiram Natarajan
Shuvra Nath
Alina Nesen
Hai Nguyen
Gen Nishida
Liliane Ntaganda
Oyindamola Oluwatimi
Leo Osvald
Maria Leonor Pacheco Gonzales
Bijeeta Pal
Servio Ernesto Palacios Interiano
Hogun Park
Kee Hwan Park
Anna Payer
Spencer Pearson
Kexin Pei
Fei Peng
Hao Peng
Hui Peng
David Perry
Romila Pradhan
Nithya Raghavan
Kiarash Rahmani
Rakshith Rangaswamy
Fang-Yu Rao
Adib Rastegarnia
Vikram Ravindra
Luke Redington
Yanfei Ren

Elkindi Rezig
Pablo Robles Granda
Checed Rodgers
Baharak Saberidokht
Asmaa Sallam
Brendan Saltaformaggio
Bo Sang
Victor Santos-Uceta
Muhammad Ihsanulhaq Sarfraz
Savvas Savvides
Derek Schatzlein
Wayne Schlei
Austin Schwartz
Isabel Scroggin
Amit Kumar Sheoran
Dong Su
Ruby Tahboub
Xi Tan
Mingjie Tang
Shin-yeh Tsai
Denis Ulybyshev
Hasini Urala Liyanage Dona Gunasinghe
Sergei Uversky
Varun Ayakulangara Vasudevan
Sri Punni Velagapudi
Luke Veldt
Leonardo Vilela Teixeira
Miguel Villarreal-Vasquez
Sudharshan Viswanathan
Fei Wang
Mu Wang
Tianhao Wang
Weihang Wang
Zhaosen Wang
Qing Wei
Yizhen Wei
Jong Ho Won
Meng-Lin Wu
Xilun Wu
Tao Wu
Pinar Yanardag Delul
Weining Yang
Jiasen Yang
Yo-Sing Yeh
Yu Hong Yeung
Yongyang Yu
Zhiwei Zhang
Junzhe Zhang
Ning Zhang
Wuwei Zhang
Xiao Zhang
Zhengyi Zhang
Samson Zhou
He Zhu
Yunxiao Zou

ENGAGEMENT

IT'S NO ACCIDENT
PENG-SIU MEI NAMED DISTINGUISHED ALUMNUS

After an outstanding career and a lifetime of community leadership, Peng-Siu Mei was presented with the CS Department's highest award and named Distinguished Alumnus of 2016 during a reception held at the Lawson Computer Science Building.

Peng's life mirrors the words of Malvolio in William Shakespeare's Twelfth Night who said, "Some are born great, some achieve greatness, and some have greatness thrust upon them." The self-proclaimed "Accidental Entrepreneur" shared the story of his 'unexpected' rise to success during a presentation (of the same title) he made to faculty, students, staff and friends of the department. Before earning his Ph.D. from the CS Department in 1971, Peng earned his A.B. in mathematics from Harvard in 1959, and an M.S. in mathematics from Brown in 1962. Peng's achievements have been innumerable, since he left the West Lafayette campus. Early in his career, from 1957 to 1973, he worked for Honeywell Information Systems. During this time, he held a number of technical and management positions, which spanned computer systems development, software development, advanced product research, and product planning. After his work with Honeywell, Peng joined Teradyne, Inc. in 1973 where he designed and delivered computer controlled systems to test automotive electronic modules. During this time, he also managed engineers and programmers to develop computer-controlled systems to test integrated circuits.

From 1976 through 1979, Peng went on to serve as Vice President and General Manager of SESA, Inc., the U.S. subsidiary of an international systems firm. His responsibilities included directing the development and marketing of minicomputer-based systems with applications in communications, manufacturing, reservation, building control, and general business. Perhaps his most significant achievement occurred in 1979, when Peng founded Mei Technology, a business initially started in his own basement, which grew over the years, employing nearly 300 individuals by 1999, when he sold the company and retired. His company became a leader in the introduction and development of new computer technologies, and in particular, in the porting of old applications from old hardware to new off-the-shelf (more economical) systems.

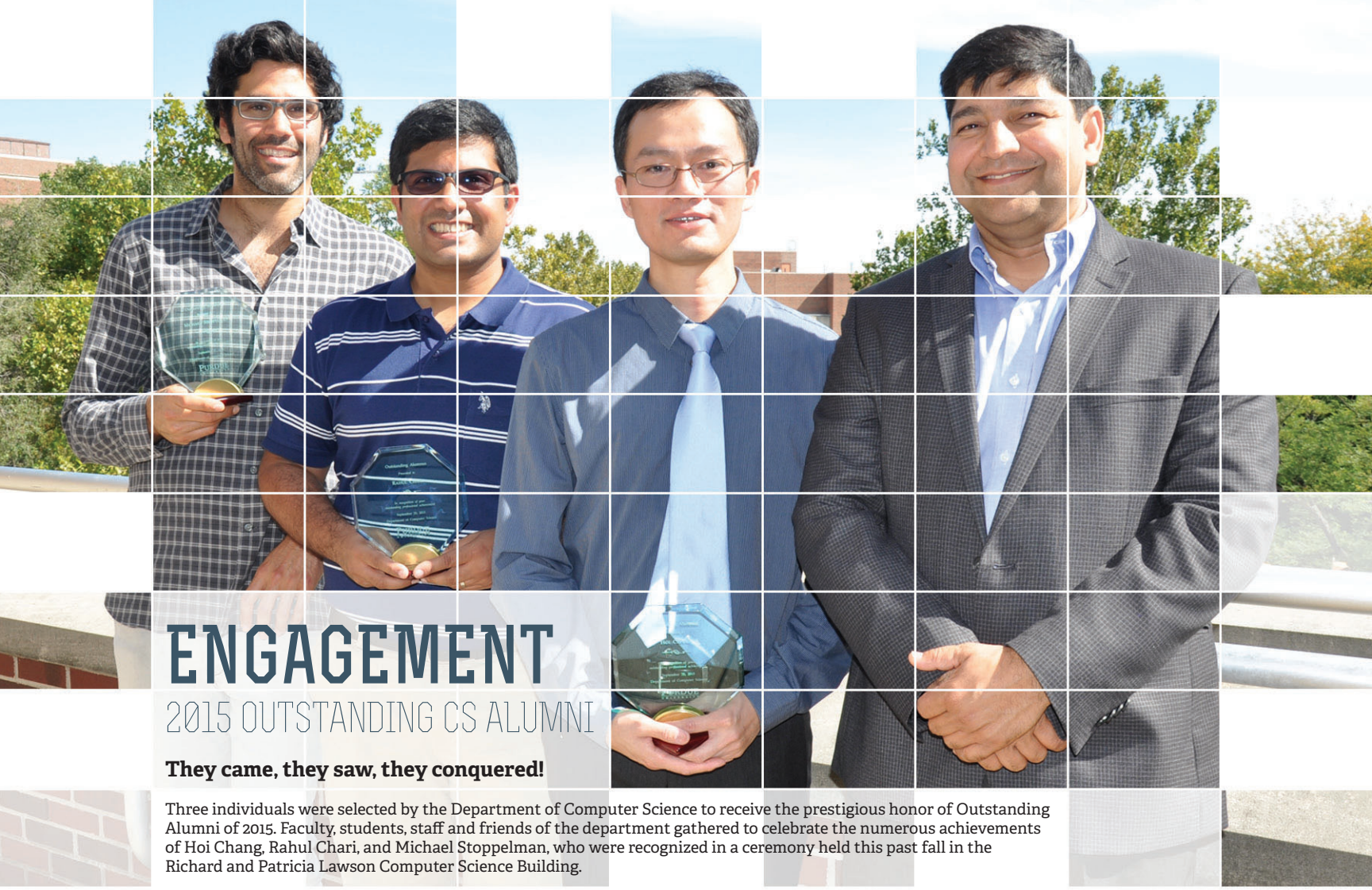
Peng's awards are numerous. In 1987 and again in 1989, he received the Outstanding Minority Business Enterprise Award from the Research and Special Programs Administration of the U.S. Department of Transportation. In 1990, he was recognized as the New England Regional Minority Small Business Person of the Year. In 1994, he was named Prime Contractor of the Year for the New England region, after being nominated by a prominent U.S. Air Force client. An impressive career history and an admirable citizen, the Department proudly records Peng's name among the elite honored on the plaque of Distinguished Alumni.

ENGAGEMENT

HATS OFF TO LEE CONGDON DISTINGUISHED ALUMNUS 2015

For more than 37 years, Lee has demonstrated his leadership qualities in both business and information technology. He earned two degrees from the department – his bachelors in 1976 and a master's in 1977. In 1989, he earned his MBA in Finance and Management Policy from the Kellogg School at Northwestern University. Lee provided a colloquium on the day of his award presentation titled, *What's Changed and What's Coming*. In his talk, Lee revisited the last 40 years of the dramatic changes in technology. He discussed what he learned at Purdue in the 1970's and its relevancy to his career. He also addressed how subsequent changes in technology have shaped the information technology and financial services industries.

Lee began his career at IBM as an operating system developer and held several technology and technical marketing positions of increasing responsibility while working there. In his current role, he serves as Red Hat's Chief Information Officer and is responsible for global information systems including the technology strategy, enterprise architecture, information technology governance, solutions delivery, and systems operations supporting the company. This includes enabling Red Hat's business through services, including technology-enabled collaboration, knowledge management, technology innovation, and process improvement. Before he joined Red Hat, Lee was managing vice president of information technology at Capital One, where he developed and delivered IT solutions for the firm's corporate functions and Global Financial Services group.Prior to his work with Capital One, Lee was the senior vice president of Strategic Initiatives at Nasdaq, where he led the organization's efforts to identify, implement, and operate technology solutions for Nasdaq Japan, Nasdaq Europe, and other strategic global ventures. Lee also worked at Citicorp, where he achieved multiple global technology initiatives for both the private and corporate banks.



ENGAGEMENT

2015 OUTSTANDING CS ALUMNI

They came, they saw, they conquered!

Three individuals were selected by the Department of Computer Science to receive the prestigious honor of Outstanding Alumni of 2015. Faculty, students, staff and friends of the department gathered to celebrate the numerous achievements of Hoi Chang, Rahul Chari, and Michael Stoppelman, who were recognized in a ceremony held this past fall in the Richard and Patricia Lawson Computer Science Building.

Hoi Chang (M.S. '98) (PhD 2003)

Hoi earned both his master's and his doctoral degrees from the department in 1998 and 2003. When Hoi was a graduate student, he collaborated with Mike Atallah (his advising professor), John Rice (professor emeritus) Tim Korb (former assistant head of the CS department), and Eric Davis (local entrepreneur) to establish Arxan Technologies. Hoi is a co-founder of the software company, which provides application-hardening tools using technologies originated from his PhD research. Throughout his twelve-year tenure with Arxan, he served as chief software architect, and later was named vice president of technology for the company. He led the creation, design, and development of major products, which have received numerous awards from the industry and propelled the company to become a leader in the commercial application-hardening space. TA Associates, a large private equity firm, acquired Arxan in 2013. Since then, Hoi has turned to his passion of being an independent app developer, creating apps for general users. He has released apps on the Mac App Store, including his most recent (and highly rated) Copy'em Paste, which is a Mac app for speeding up clipboard-related workflows.

Rahul Chari (M.S. 2001)

Rahul earned his master's degree in 2001 and was advised by Department Head Sunil Prabhakar while he was a student. Rahul is the Vice President of Engineering for Flipkart, which he joined in 2011 through the acquisition Mallers Inc. He currently spearheads the supply chain technology division and leads the charge to build the best-in-class supply chain management system for e-commerce covering order management, warehousing and transport management and eCommerce fulfillment innovation to create value for customers at Flipkart. Prior to Flipkart, Rahul co-founded Mallers, Inc. and served as its Chief Technology Officer. He built MIME360, the flagship product of Mallers Inc., which was a platform for management and distribution of digital content to various legal online streaming sites and apps. Before his work with Mallers, Rahul worked at Cisco Systems, where he was part of the team that developed the market changing MDS 9000 family of SAN switches. He has architected and executed the development of solutions, such as SAN Based Data Migration and Extended SCSI Copy for the SAN. Rahul is named on multiple storage virtualization related patents and has been actively involved in storage technologies and standards such as SCSI, Fibre Channel, iSCSI and RAID.

Michael Stoppelman (B.S. 2003)

Michael earned his bachelor's degree from the department in 2003. In 2007, he joined Yelp as a software engineer and rebuilt the company's search engine. Yelp develops, hosts and markets Yelp.com and the Yelp mobile app, which publishes crowd-sourced reviews about local businesses. Yelp—the modern-day yellow pages—is used by millions of consumers everyday who seek reliable reviews and information, ranging in searches for the best restaurant to the most prominent cardiologist (in a specific area). Michael has been promoted to several senior roles during his career with the company. As the current vice president of engineering, he is responsible for overseeing the company's rapidly expanding engineering team and leads the company's technical recruiting efforts. Prior to his work with Yelp, Michael was a senior software engineer and tech lead for the AdSense Traffic Quality team at Google.

GUEST SPEAKERS

Lotfi ben Othmane - 8/19/2014
Incorporating Attacker Capabilities in Risk Estimation and Mitigation
Fraunhofer SIT, Germany

Alejandro P. Buchmann - 8/25/2014
UkuFlow and TUμNet: A Platform for Application Development on Wireless Sensor-Actuator Networks and a Metropolitan Scale Testbed
Technical University of Darmstadt

Weili Han - 8/26/2014
Empirical Study on Chinese Web Passwords
Fudan University

Elaine Shi - 8/27/2014
Tree-based Oblivious RAM and Applications
University of Maryland

Rean Griffith - 9/16/2014
Enabling Hadoop for the Cloud: Virtualization, Data-Management and Storage Optimizations
VMware

Thomas Ristenpart - 9/26/2014
Getting to the Cloud and Using it, Securely
University of Wisconsin-Madison

Grace Ngai - 10/16/2014
Service Learning as a Requirement – Implementations and Pedagogy
Hong Kong Polytechnic University, Hong Kong

Pradeep Dubey - 11/7/2014
Big Data: An Opportunity Knocking on the Doors of Computing
Director of Parallel Computing Lab, Intel Labs

Petros Drineas - 11/24/2014
RandNLA: Randomized Algorithms in Numerical Linear Algebra Petros Drineas
Rensselaer Polytechnic Institute

Matthew Fredrickson - 12/15/2014
Inference Attacks: Understanding Privacy in the Era of "Privacy is Dead"
University of Wisconsin-Madison

Bruno Ribeiro - 1/15/2015
Mining and Predicting a Complex Networked World: Theory, Models and Applications
Carnegie Mellon University

Jeremiah Blocki - 1/20/2015
Usable and Secure Human Authentication
Carnegie Mellon University

Conte Distinguished Lecture,
Dana Randall - 1/21/2015
Phase Transitions in Algorithms and Applications
Georgia Tech

Stephen Checkoway - 1/22/2015
Revealing Reality Through Reverse Engineering
Johns Hopkins University

Arnab Nandi - 1/23/2015
Building Interactive Database Systems
Ohio State University

Jean Honorio - 2/2/2015
Learning Structure from Data: Applications, Algorithms, Statistical Efficiency and General Frameworks
MIT CSAIL

Ardaian Amiri Sani - 2/5/2015
Rethinking System Support for I/O Devices
Rice University

Nadav Amit - 2/9/2015
Addressing Common Virtualization Shortcomings
Israel Institute of Technology

Milos Gligoric - 2/10/2015
Regression Testing for Modern Development
University of Illinois at Urbana-Champaign

Aniket Kate - 2/12/2015
Minimal Trusted Hardware Assumptions for Privacy-Preserving Systems
Saarland University in Germany

Sudeepa Roy - 2/16/2015
Taming the Big Data Elephant with Query Explanations
University of Washington

Zuehai Qian - 2/19/2016
Taming Relaxed Memory Consistency and Non-determinism in Parallel Systems
University of California Berkeley

Uiannan Wang - 2/23/2015
Making data analysis really about analysis
UC Berkeley

Ankit Singla - 2/26/2015
Jellyfish: Networking Data Centers, Randomly
University of Illinois at Urbana-Champaign

Debmalya Paigrahi - 3/2/2015
Network Algorithms in the Internet Era
Duke University

Hemanta K. Maji - 3/3/2015
Resilient Building Blocks for Secure Computation
University of California

Yiying Zhang - 3/6/2015
Rethinking Storage Vertically
University of California, San Diego

Paraschos Koutris - 3/9/2015
Building the Foundations of Data Management for the Modern Era
University of Washington

Aditya Bhaskara - 3/10/2015
New Algorithmic Techniques in Machine Learning
Google Research, NYC

Swarun Kumar - 3/12/2015
Pushing the Limits of Wireless Networks: Interference Management and Indoor Positioning
MIT

Karthik Raman - 3/23/2015
Man+Machine: Machine learning with Humans-in-the-Loop
Cornell University

Yinan Li - 3/25/2015
Analytic Query Processing at Bare Metal Speeds
University of Wisconsin-Madison

Anshumali Shrivastava - 3/26/2015
An Excursion in Probabilistic Hashing Techniques for Big Data
Cornell University

Alekh Jindal - 3/30/2015
Towards One-Size-Fits-All Data Systems
MIT

James Faghmous - 3/31/2015
Data-Intensive Scientific Discovery in the Big Data Era
University of Minnesota

Prasang Upadhyaya - 4/2/2015
Managing Premium Data
The University of Washington

Ruta Mehta - 4/7/2015
Games, Equilibria, and Evolution
Indian Institute of Technology, Bombay

Michael Kapralov - 4/9/2015
lgorithms for Modern Graph Analysis
IBM T.J. Watson Research Center

Yinzhi Cao - 4/13/2015
Enhancing System Security and Privacy with Program Analysis
Columbia University

Walter S. Lasecki - 4/15/2015
Crowd-Agents: Creating Crowd-Powered Interactive Systems
University of Rochester

Danai Koutra - 4/16/2015
What's in my data? Fast, principled algorithms for exploring large graphs
Carnegie Mellon University

Distinguished Alumnus,
Lee Congdon - 4/17/2015
What's Changed and What's Coming
Red Hat

Zachary Kincaid - 4/20/2015
Parallel Proofs for Parallel Programs
University of Toronto

Elias Bareinboim - 4/21/2015
Generalizability in Causal Inference
University of California, Los Angeles

Lin Tan - 4/21/2015
Defect Detection and Prediction Through Text Analytics
University of Waterloo

Murali Krishna Ramanathan - 4/21/2015

Vijay Chidambaram - 4/23/2015
Performance and Reliability in Modern Storage Systems
University of Wisconsin-Madison

Manish Gupta - 9/17/2015
Data Analytics for Personalized Services and Transforming Lives
Xerox Corporation

Shuo Chen - 9/22/15
Enabling Real-World Online-Service Developers to Verify Their Protocol Implementations
Microsoft Research Redmond

Conte Distinguished Lecture,
Gerhard Weikum - 10/1/2015
Big Text Data: from Names and Phrases to Entities and Relations
Max-Planck Institute for Informatics (MPII) in Saarbruecken, Germany

Carlos Vanegas - 10/9/15
Urban Modeling and Visualization: A Path from PhD Research to Startup to Commercialization
Synthicity Berkeley, California

Indrigit Roy - 10/14/2015
Practical Systems that Leverage Main Memory and Non-Volatile Memory
Hewlett Packard Labs

Rahul Sharma - 10/15/2015
Proofs for Performance
Stanford University

Xiangyu Zhang - 10/20/2015
Forced-Execution of Binaries and iOS Apps to Disclose Malicious Behavior
Purdue University

Professor Michael Bailey - 10/22/2015
Measuring, Modeling, and Predicting Internet Abuse
University of Illinois at Urbana Champaign

Dimitrios Koutsonikolas - 10/26/2015
Enabling Motion Detection on Commodity WiFi Devices using PHY Layer Information
University at Buffalo, SUNY

Ruijum Zhao - 10/26/2015
Optimal Control Theory and its Application in a Malaria Model
Minnesota State University

Dave Schrader - 11/3/2015
Cutting-Edge Analytics for Business, Non-Profits, and Sports Teams
Teradata Corporation

Kevin Brown - 11/5/2015
Have Abstraction and Eat Performance Too: Optimized Heterogeneous Computing with Parallel Patterns
Stanford University

Chenggang Wu - 11/5/2015
Reproducing Concurrency Bugs Using Local Clocks
Berekely

Yung-Hsiang Lu - 11/16/2015
Opportunities and Challenges in Global Network Cameras
Purdue University

Yiying Zhang - 11/23/2015
Rethinking Data Center Racks Vertically
Purdue University

Alex Liu - 12/2/2015
Algorithmic Approaches to Networking and Security
Michigan State University

Zhiqiang Lin - 12/3/2015
Automatic Generation of Authenticated Messages for Security Testing of Mobile Services
University of Texas at Dallas

Conte Distinguished Lecture,
Andreas Zeller - 12/7/2015
Mining Sandboxes for Security
Saarland University

Mohammad Sadoghi - 12/7/2015
When velocity and volume meet, and beyond ...
IBM T. J. Watson Research Center

Carlee Wong - 12/17/2015
Smart Data Pricing
Princeton University

Dr. Deeparnab Chakrabarty - 1/11/2016
Understanding Wolfe's Heuristic: Submodular Function Minimization and Projection onto Polytopes
Microsoft Research

Dr. Kyle Fox - 1/14/2016
Geometry and Topology Meet Graph Algorithms
Duke University

Ahmed Eldawy - 1/19/2016
SpatialHadoop: A MapReduce Framework for Big Spatial Data
University of Minnesota

Xin Jin - 1/21/2016
Dynamic Control of Software-Defined Networks
Princeton

Arun Kumar - 1/25/2016
Making it Easier to Build and Deploy Advanced Analytics
University of Wisconsin Madison

Paul Hovland - 1/26/2016
Program Analysis and Transformation for Scientific Computing
Argonne National Laboratory

Vincent Liu - 2/4/2016
Improving the Cost and Reliability of Data Center Networks
University of Washington

Arjun Radhakrishna - 2/8/2016
Program Synthesis: Beyond Correctness
University of Pennsylvania

Ce Zhang - 2/11/2016
DeepDive: A Data Management System for Machine Learning Workloads
Stanford University

Byoungyoung Lee - 2/15/2016
Protecting Computer Systems by Eliminating Vulnerabilities
Georgia Institute

Andrei Stefanescu - 2/18/2016
Toward language-independent program verification
University of Illinois at Urbana-Champaign

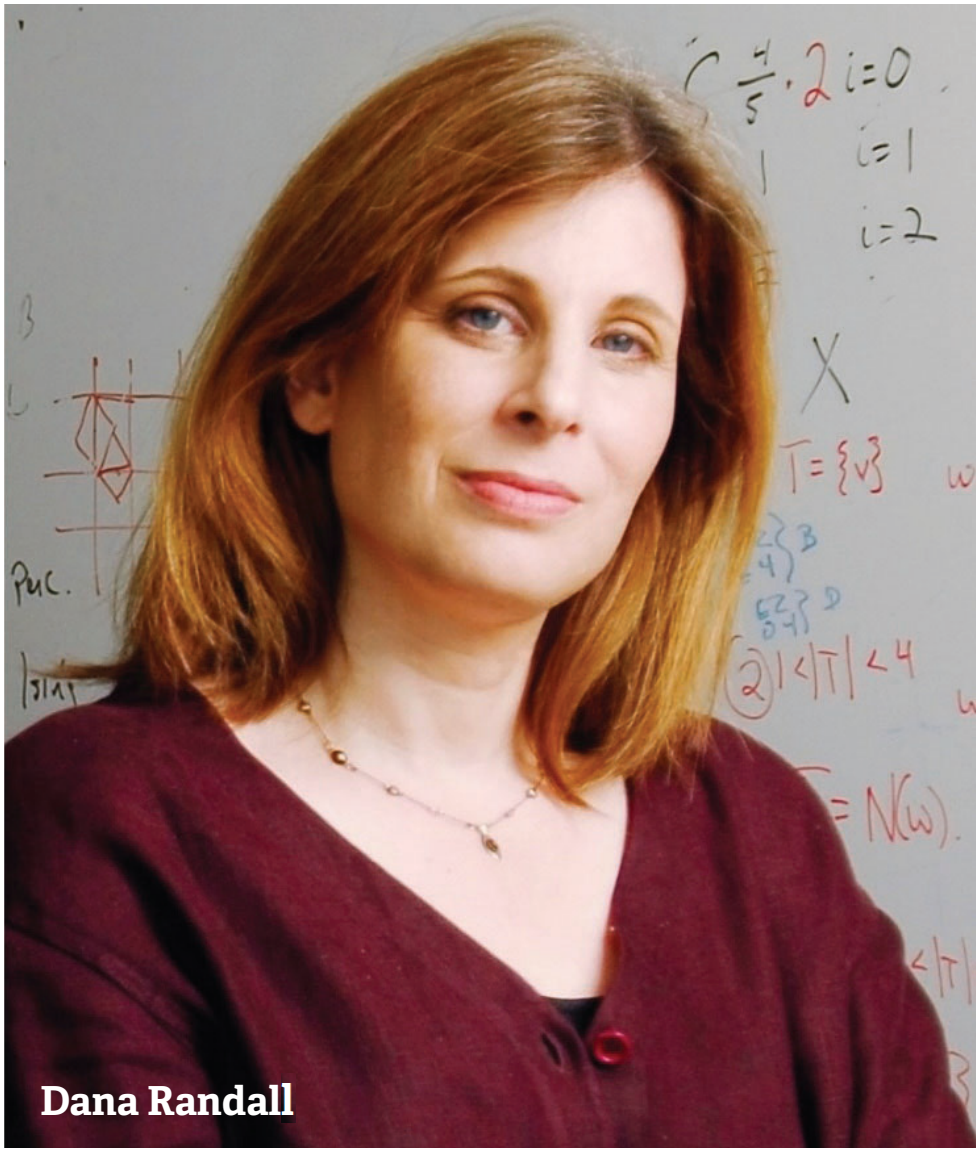
Michael Forbes - 2/22/2016
Randomness, Algebra, and Computation
Princeton University

Hongqiang Liu - 2/25/2016
Fill but do not spill: achieving efficiency and robustness simultaneously in cloud infrastructures
Microsoft Research, Redmond Lab

Roopsha Samanta - 2/29/2016
Computer-aided Programming for Concurrency and Beyond
Institute of Science and Technology Austria

Benjamin Delaware - 3/2/2016
Synthesis by Fiat
MIT

He Wang - 3/3/2016
I am a Mobile Device and I can Sense my User's Location
University of Illinois at Urbana-Champaign



Qixing Huang - 3/7/2016
Visual Computing Using Big 3D Data
Toyota Technical Institute

Alec Jacobson - 3/10/2016
Breaking Barriers between Humans and Geometry
Columbia University

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FACILITIES

Facilities Overview
The Computer Science Department is dedicated to providing high-quality computing facilities for use by faculty, students, and administrative personnel. The facilities are operated by Department and College of Science technical staff who are responsible not only for the installation, repairs, and maintenance of the systems, but who also assist faculty and students with equipment acquisitions and support for instructional and research projects.

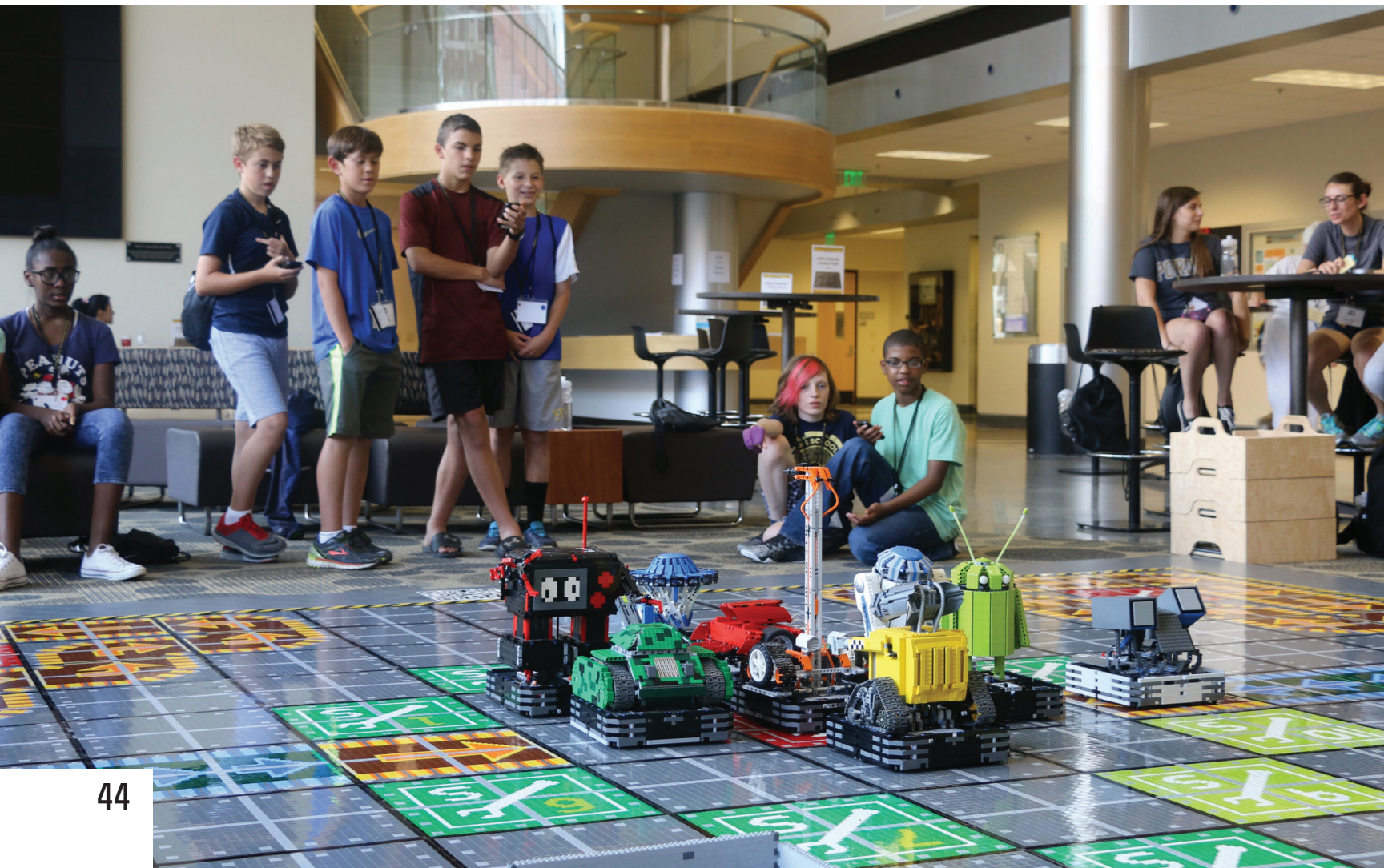
General Facilities
General Department computing facilities are available for both administrative activities (such as the preparation of research reports and technical publications) and research needs that are not supported by other dedicated equipment. The main server systems are multi-core multiprocessors with large main memories and large disk arrays for storage. A variety of workstations and laptops are used by faculty, staff, and students throughout the Department. The Department has also purchased compute nodes in the Hammer, Rice and Snyder supercomputing clusters and terabytes of storage space in the SAN managed by the central research IT service on campus (RCAC). These resources are available to all Department researchers, and additional nodes/storage are available for individual purchase.

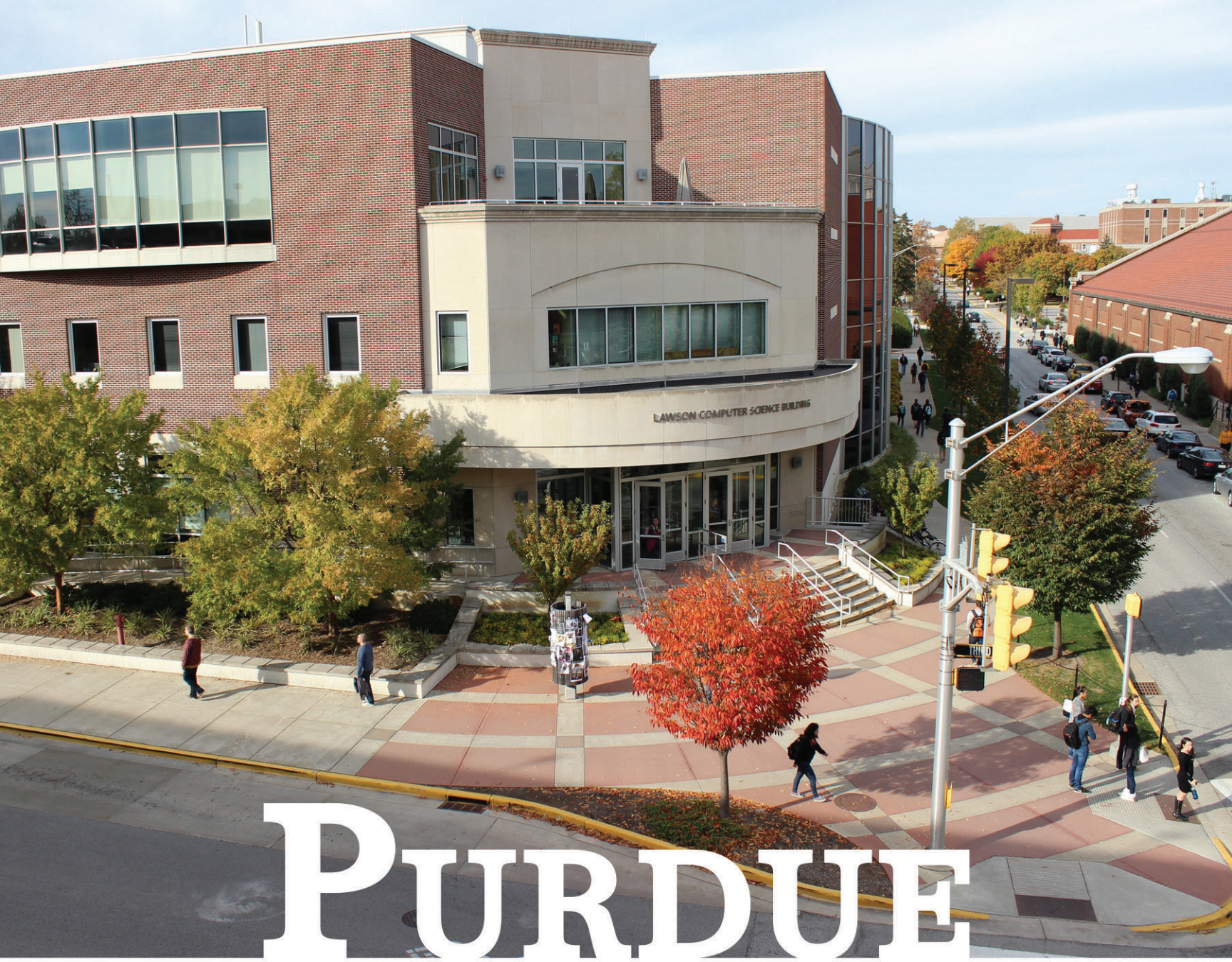
Instructional Facilities
The Department operates eight instructional laboratories for both undergraduate and graduate Computer Science courses. They include over 200 X86-based workstations running Linux and Windows. Two of the labs are collaborative labs dedicated to group learning with the assistance of interactive technology. The devices instructional lab includes a locker system that allows convenient access for students to a number of devices such as the latest Raspberry Pi technology, Oculus Rift VR goggles, Parrot Drones, and Leap Motion controllers. This lab is open to CS students and student groups for experimentation with some of the latest technology. The new (spring 2016) graphics lab includes workstations with Nvidia GTX 970 GPUs to support CUDA development in CS graphics courses.

I/O Equipment
The Department operates more than 60 laser printers, eight of which are multi-function. There are 10 conference rooms with 80" displays, and audio and video conferencing equipment. The Department also has mobile video conferencing stations and digital video cameras. The main atrium of the building features a 184" video wall for educational, informative, and recreational use.

Networking Services
The Department has state-of-the-art networking technology to provide access to systems in the department, across campus, and throughout the world. All desktop connections are 1Gbps. The core infrastructure is 10 Gbps and the wiring in the Lawson Computer Science building supports 10Gbps to the desktop. There are over 75 Ethernet VLAN-capable switches from Dell, Force10, and Cisco Systems. This network infrastructure is connected to the campus backbone by redundant fiber links. The campus is connected to multiple high speed Internet backbones, including Abilene/Internet2 and I-Light. DSL, cable, fiber, and cellular data services are available in the community for remote access from home.

Information Technology at Purdue (ITaP)
ITaP, the central campus IT group, supports general instructional labs, wireless networking, and presentation facilities in classrooms. ITaP's Research Computing (RCAC) group also maintains multiple supercomputing clusters and large storage area networks for course and research computing.





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