

NC STATE Engineering

CSC NEWS

DEPARTMENT OF COMPUTER SCIENCE | FALL 2018



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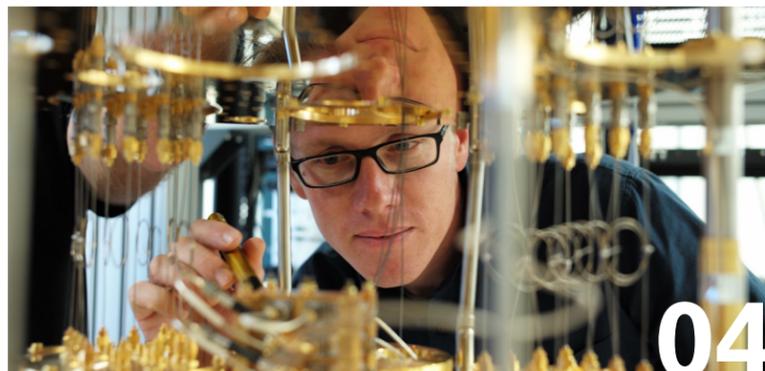
NEW DEPARTMENT HEAD NAMED: PAGE 02

Dr. Gregg Rothermel, widely considered one of the top software engineering researchers in the world, will join CSC as the new department head on Nov. 1.



ABOUT THE COVER

NC State will be the first university in North America to establish an IBM Q Hub as part of the global IBM Q Network, a collaboration with tech powerhouse IBM that will advance quantum computing. Learn more on page 4.



WHAT'S NEW IN CSC PAGE 04

From on-campus events to new labs and research breakthroughs, the Department continues to grow and innovate.



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Computer Science faculty members are being recognized by a number of organizations for their groundbreaking research.



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Our students are earning prestigious fellowships and being honored by NC State for their work inside and outside the classroom.

LETTER FROM THE DEPARTMENT HEAD LAURIE WILLIAMS



Dr. Laurie Williams

Greetings friends and alumni of the NC State Computer Science Department! We've just completed a fun-packed 50th Anniversary celebratory year, and I'm excited to share some of the highlights.

The Department's 50th year anniversary celebrations last fall were a huge success! There were many memorable events, from the NC State vs. Louisville football game, to the Centennial Rocks concert featuring the Bull City Syndicate, to the 50th Year Technical Symposium and Reception! One special highlight was the induction of the inaugural class of the Computer Science Alumni Hall of Fame. Thank you to our more than 20 Super ePartners and ePartners for your support in making this celebration one for the history books, quite literally! (More information about the 50th year events are included elsewhere in this newsletter.)

In addition to celebrating our past, we can also celebrate the many current successes the Department, including our students, faculty and staff, has experienced over the past year. Here are a few that deserve special notice:

- NC State will be the first university in North America to establish an IBM Q Hub as part of the global IBM Q Network, a collaboration between tech powerhouse IBM and top Fortune 500 companies, national research labs and leading universities to advance quantum computing. Starting in the fall of 2018, NC State will have access to IBM Q commercial quantum computing devices, including the most advanced and scalable universal systems available;
- NC State has again been awarded a Science of Security Lablet by the National Security Agency (NSA) to continue its work in developing the cybersecurity and privacy breakthroughs needed to safeguard cyberspace. Lablets are small multi-disciplinary labs at leading U.S. research institutions that are part of NSA's Science of Security and Privacy (SoS) Initiative, which was launched in 2012;
- NC State's online graduate program in computer science moved up two spots to No. 4 on the latest *U.S. News & World Report* ranking of online degree programs, making it one of the highest ranked online programs at the university;
- Dr. Kathryn Stolee is the department's most recent recipient of an NSF CAREER Award. She becomes the 29th NSF CAREER Award winner in the NC State Computer Science Department (23rd currently on faculty), one of the highest concentrations of any department in the nation;
- Dr. Donald Bitzer was named a Fellow by the National Academy of Inventors (NAI). He was recognized for co-inventing the flat plasma display panel in 1964. The technology was eventually applied to television screens, and millions of plasma TVs have been sold to the public since being introduced in the 1990s;
- Dr. Min Chi was awarded the Alcoa Foundation Engineering Research Achievement Award, which recognizes faculty members who have accomplished outstanding research achievements during the preceding three years;
- Research is key to our mission, and research productivity stands at more than \$62M in active research grants. Annual expenditures are in the \$10M range;
- Our graduates continue to be in high demand with annual salaries for undergrads in the \$70,000 range, and those graduating with an M.S. bringing in close to \$110,000. We continue to be the top supplier of talent to IBM, Cisco, NetApp, SAS and other top financial and IT organizations, as well as other high-tech companies.

As I wrap up my final months as interim department head, I would like to send out a heartfelt thank you to the faculty members and staff who have served along with me over the past 18+ months. It is an honor to work alongside some of the most accomplished professionals at NC State. We look forward to welcoming our new department head, Gregg Rothermel, as he takes the reigns of the Department on November 1. (Be on the lookout for opportunities to meet Dr. Rothermel. More information will be posted on the Computer Science website and invitations will be sent out.) Hope to see you soon!

Dr. Laurie Williams

Interim department head and professor

Meet our new department head **DR. GREGG ROTHERMEL**



AFTER AN EXHAUSTIVE YEAR-LONG INTERNATIONAL SEARCH, we are extremely excited to announce that Dr. Gregg Rothermel will become the department's 6th department head, joining us officially on November 1st, 2018.

An IEEE Fellow and ACM Distinguished Scientist, Gregg comes to us from the University of Nebraska-Lincoln where he was professor and Jensen Chair of Software Engineering. Widely considered one of the top software engineering researchers in the world, his findings have been cited by thousands of researchers around the globe.

Voicing excitement about this new chapter in his life, Gregg said his visits to NC State revealed a department with a very talented and collegial faculty and staff, leading an impressive number of highly successful research efforts. "This department has been blessed by years of strong leadership," says Gregg. "This is such an exciting place and I am honored to have the opportunity to build on the success of these leaders. I'm looking forward to joining the department, and getting to know our faculty, staff, alumni and partners better. This department is poised for tremendous success, and together, we can make it happen."

Gregg's research interests include software engineering and program analysis, with emphases on the application of program analysis techniques to problems in software maintenance and testing, end-user software engineering, and empirical studies. He is a co-founder of the ESQuaReD (Empirically-Based Software Quality Research and Development) Laboratory at the University of Nebraska-Lincoln. He is also a co-founder of the EUSES (End-Users Shaping Effective Software) Consortium, a group of researchers who, with National Science Foundation support, have led end-user software engineering research. He co-founded and leads the development of the Software-Artifact Infrastructure Repository (SIR), a repository of software-related artifacts that support rigorous controlled experiments with program analysis and software testing techniques, and has been utilized, to-date, by more than 3,500 persons from more than 700 institutions around the world, supporting more than 800 scientific publications. His research has been supported by NSF, DARPA, AFOSR, Boeing Commercial Airplane Group, Microsoft, and Lockheed Martin.

He is currently general co-chair for the 2020 ACM/IEEE International Conference on Software Engineering, serves as an associate editor for *IEEE Transactions on Software Engineering and Methodology*, and is a member of the editorial boards of the

"This department has been blessed by years of strong leadership. This is such an exciting place and I am honored to have the opportunity to build on the success of these leaders. I'm looking forward to joining the department, and getting to know our faculty, staff, alumni and partners better. This department is poised for tremendous success, and together, we can make it happen."

- DR. GREGG ROTHERMEL

Empirical Software Engineering Journal and *Software Quality Journal*.

Previous positions include associate editor in chief for *IEEE Transactions on Software Engineering*, general chair for the 2009 International Symposium on Software Testing and Analysis, program co-chair for the 2007 International Conference on Software Engineering, and program chair for the 2004 ACM International Symposium on Software Testing and Analysis.

Gregg received his Ph.D. in computer science from Clemson University, his M.S. in computer science from SUNY Albany, and a B.A. in philosophy from Reed College. Prior to returning to academia, he was a software engineer, and vice president of quality assurance and quality control, for Palette Systems, a manufacturer of CAD / CAM software.

A series of Meet the New Department Head events are planned for the spring of 2019 across the state and in areas where we have large alumni groups, including Seattle and Silicon Valley. Look for an event near you and come out to meet Gregg.

NC State named first university-based IBM Q Hub in North America

NC State will be the first university in North America to establish an IBM Q Hub as part of the global IBM Q Network, a collaboration between tech powerhouse IBM and top Fortune 500 companies, national research labs and leading universities to advance quantum computing.

The network provides early access to IBM's quantum computing systems, with the goal of exploring practical applications important to business and science.

Starting this fall, NC State will have access to IBM Q commercial quantum computing devices, including the most advanced and scalable universal systems available. The current 20 qubit IBM Q system will be followed by a 50-qubit prototype in the next generation.

WHAT IS QUANTUM COMPUTING?

While the field is still in its infancy, quantum holds the promise of solving problems far beyond the capabilities of ordinary computers. Instead of relying on conventional bits (binary digits, ones and zeroes) to store information, quantum computers use "qubits," which can represent multiple states at once — a phenomenon known as superposition. They can work on problems in parallel and potentially find solutions to problems too complex for any classical machine to compute.

Quantum computing could prove momentous for complex optimization, molecular modeling, machine learning, physics, materials science, chemical simulations and data discovery. By better understanding molecular interactions, quantum computing could:

- Help researchers create new medicines or materials
- Deliver a product across the globe with the least amount of fuel
- Manage risk in constantly fluctuating financial markets
- Train artificial intelligence

THE LATEST IN A LONG PARTNERSHIP

For three decades, IBM and NC State have worked together across research, education and advanced technology development, yielding breakthroughs in cloud computing, advanced analytics, cybersecurity, renewable energy, advanced networking and healthcare IT. In 2016, IBM opened its Education Innovation Center on Centennial Campus, a collaboration space for NC State students and faculty members and IBM employees to uncover solutions.

In this latest partnership, NC State joins three established university-based quantum computing hubs worldwide: the University of Oxford, Keio University and the University of Melbourne. Hubs within IBM's network are critical for accelerated learning, skills development and the global rollout of quantum computing.

"Academic collaborations are essential to growing the quantum computing community as we look to discover practical quantum applications and drive business and scientific breakthroughs," said Bob Sutor, vice president of IBM Q Strategy and Ecosystem, IBM Research. "Building on a 30-year research and education partnership, NC State will play a key role in helping IBM continue to extend our quantum computing ecosystem."

"The hub will create a unique opportunity for NC State to address its strategic plan of supporting interdisciplinary scholarship and preparing students for the future," said Dr. Alan Rebar, vice chancellor for research and innovation at NC State. "Our researchers and students will work with IBM scientists, engineers and consultants to further explore and advance quantum computing. The hub, which will be operated from NC State's Centennial Campus, will also drive new curriculum development at NC State, focused on quantum computing."



National Security Agency renews Science of Security Lablet at NC State

NC State has again been awarded a Science of Security Lablet by the National Security Agency (NSA) to continue its work in developing the cybersecurity and privacy breakthroughs needed to safe guard cyberspace.

The Science of Security Lablet at NC State was established in 2012. NSA this spring announced that NC State would again host a Lablet for an additional five years under a new contract.

Science of Security Lablets are small multi-disciplinary labs at leading U.S. research institutions that are part of NSA's Science of Security and Privacy (SoS) Initiative. SoS promotes security and privacy science as a recognized field of research and encourages rigorous research methodologies.

Under the latest contract, the University of Kansas, Vanderbilt University and the International Computer Science Institute will join three of the original SoS Lablets established in 2012: Carnegie-Mellon University, University of Illinois Urbana-Champaign and NC State.

The NC State Lablet was tasked with working on five "hard problems" when it was established.

Scalability and Composability: The challenge of this problem is to develop methods enabling the construction of secure systems with known security properties.

Policy-Governed Secure Collaboration: Projects addressing this hard problem seek to develop methods to express and enforce normative requirements and policies for handling data with differing usage needs and among users in different authority domains.

Predictive Security Metrics: The challenge of this problem is to develop security metrics and models capable of predicting whether or confirming that a given cyber system preserves a given set of security properties (deterministically or probabilistically), in a given context.

Resilient Architectures: The challenge of developing the means to design and analyze system architectures that deliver required service in the face of compromised components.

Human Behavior: Modeling human behavior is a daunting task,

and projects addressing this hard problem seek to develop models of human behavior (of both users and adversaries) that enable the design, modeling, and analysis of systems with specified security properties.

Those same five problems will continue as the focus for the next five years, said Dr. Laurie Williams, professor and interim department head in the Department of Computer Science and principal investigator of the NC State Lablet.

Three projects have been selected for work in the NC State Lablet in the first year of the new five-year contract.

- Dr. Xiaohui (Helen) Gu (NC State) Coordinated Machine Learning-Based Vulnerability and Security Patching for Resilient Virtual Computing Infrastructure
- Dr. Ninghui Li (Purdue University) Principals of Secure BootStrapping for IoT
- Dr. Laurie Williams (NC State) and Dr. Andy Meneely (Rochester Institute of Technology) Predicting the Difficulty of Compromise through How Attackers Discover Vulnerabilities

The SoS Lablets will focus on the discovery of formal underpinnings of the design of trusted systems, which spans the disciplines of computer science, electrical engineering, mathematics, behavioral science, statistics, philosophy, public policy and physics. Lablet researchers are free to work with other institutions as needed. The Lablets are starting 20 projects in the following research areas: Challenges in Cyber-Physical Systems, Cybersecurity Metrics, Policy-Governed Secure Collaboration, Privacy, Resilient Architectures, Scalability and Composability and Understanding and Accounting for Human Behavior.

The Lablets were competitively selected from a solicitation of nearly 300 universities across the United States. The criteria for selection included scientific rigor of research projects, applicability to current challenges and efforts to grow a scientific community in security and privacy.

Learn more about the NC State Lablet at research.csc.ncsu.edu/security/lablet.



Photo credit: Tamahikari Tammas

New tool increases adaptability, autonomy of “Skyrim” nonplayer characters

Computer science researchers at NC State and Universidade de Lisboa have developed a tool for use with the game “Skyrim” that can be used to create nonplayer characters (NPCs) that allow for more variability and flexibility in game play. The tool, called CIF-CK, is an artificial intelligence (AI) architecture program that uses social behavior models to make individual NPCs more reactive and adaptable to player behavior.

“Most games now rely on scripts to govern NPC behavior,” says Arnav Jhala, an associate professor of computer science at NC State and co-author of a paper describing the work. “In other words, there are decision trees that dictate an NPC’s response to whatever the player is doing. That’s fairly limiting, and means that any two players that make the same decisions will have the same interactions with NPCs. We want to move beyond that, to a more immersive gaming experience. And “Skyrim” was the game we started with.”

To develop CIF-CK, the researchers built on the Comme il-Faut (CIF) AI architecture model first developed at the University of California-Santa Cruz in 2012.

The original CIF model used social science theory to predict how the behavior of one “agent” would affect how other agents viewed it. For example, if Agent A was nice to Agent B, and Agent X hated Agent B, then Agent X would be less likely to “like” Agent A.

CIF-CK incorporates the approach of that model into its software, but extends it in two ways.

First, all of the agents in CIF know about all of the other agents. That’s not necessarily true in CIF-CK – it’s up to the

game developer. In short, each NPC will know as much (or as little) as the developer wants it to know.

Second, CIF tracked changes in how agents viewed each other, but didn’t translate those perceptions into actions. E.g., Agent X may not like Agent A, but the original CIF model didn’t predict what Agent X would do about it. But CIF-CK allows NPCs to make actions based on how they view a player – and that, in turn, is based on what they know of the player’s interactions with other players and NPCs.

The researchers have made a prototype of CIF-CK available on the online STEAM community site under the name “Social NPCs,” in part to see how the tool performed when used by Skyrim players. And the response has been positive, with the tool garnering more than 6,700 subscribers.

“This work demonstrates that tools like CIF-CK can be implemented on a large scale,” Jhala says. “We’re now hoping to work with gaming companies and game developers to incorporate the CIF-CK approach into their development processes – or at least get inspired by it.”

“And, of course, we’re always working to make AI more expressive and capable of further enhancing the game-playing experience.”

The paper, “CiF-CK: An Architecture for Social NPCs in Commercial Games,” was presented at the IEEE Conference on Computational Intelligence and Games held last summer in New York City. Lead author of the paper is Manuel Guimaraes, a graduate student at Universidade de Lisboa. The paper was co-authored by Pedro A. Santos of Universidade de Lisboa.

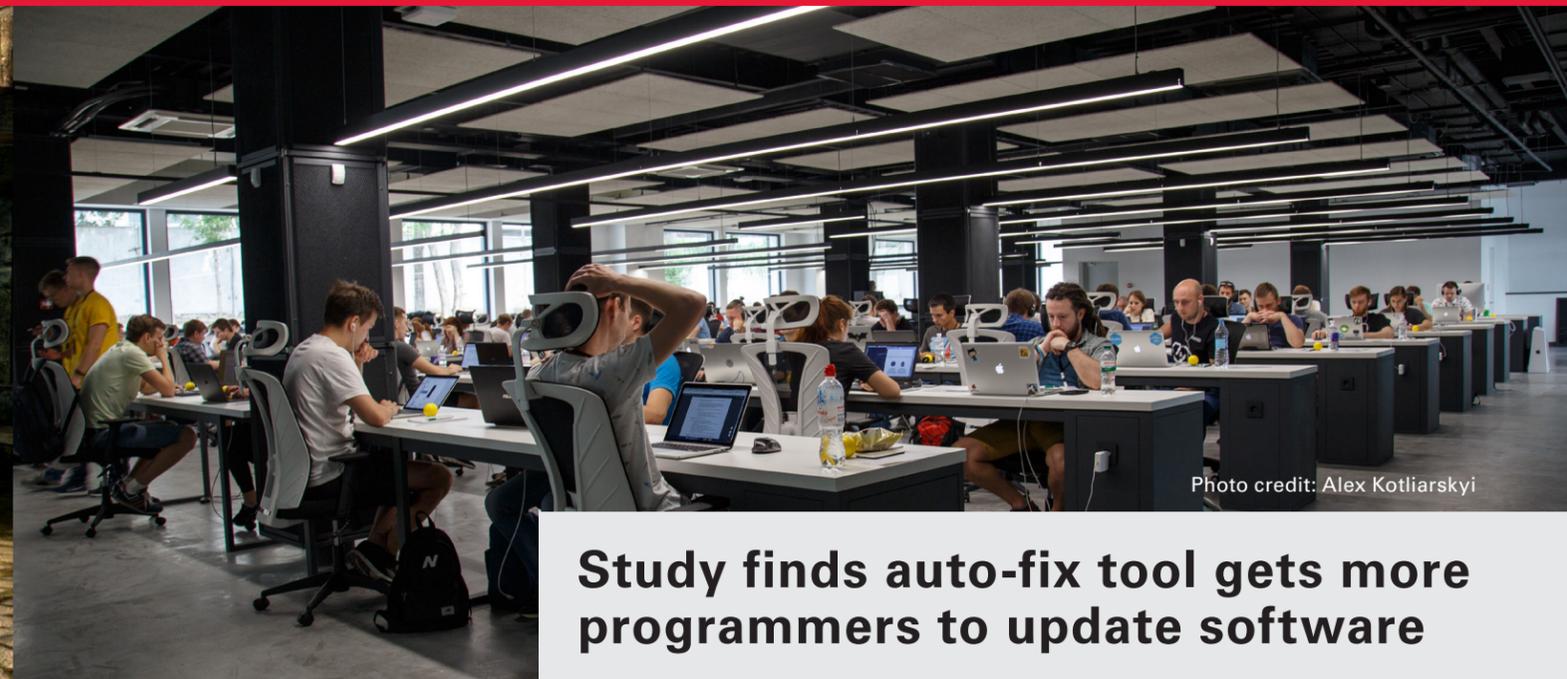


Photo credit: Alex Kotliarskyi

Study finds auto-fix tool gets more programmers to update software

Failure to make necessary upgrades to software code can have dire consequences, such as the major data breach at Equifax. A recent study finds that auto-fix tools are effective ways to get programmers to make the relevant upgrades – if programmers opt to use them.

“Most software programs rely, in part, on code in external ‘libraries’ to perform some of their functions,” says Dr. Chris Parnin, an assistant professor of computer science at NC State and senior author of a paper on the work. “If those external libraries are modified to address flaws, programmers need to update their internal code to account for the changes. This is called ‘upgrading an out-of-date dependency.’ However, for various reasons, many programmers procrastinate, putting off the needed upgrades.

“This is what happened at Equifax,” Parnin says. “An external library they relied on had made public that it contained a security flaw. And while the external library was patched, Equifax never got around to updating its internal code. So months after the problem was identified, Equifax was still vulnerable and got hacked.

“Our goal with this project was to assess tools designed to get more programmers to upgrade their out-of-date dependencies. Could they help prevent another Equifax?”

For this study, the researchers looked at thousands of open-source projects on GitHub, an online programming community that fosters collaboration on open-source software projects. Specifically, the researchers looked at different means projects used to incentivize or facilitate upgrades and whether those incentives made any difference.

One group consisted of 2,578 projects that utilized

automated pull requests, which notified project owners of needed upgrades to out-of-date dependencies, proposed potential code changes, and ran a small battery of tests to determine if the replacement code was viable. These project owners were still required to approve the changes or modify updated code if it failed initial viability tests.

A second group consisted of 1,273 projects that did not utilize incentives to upgrade out-of-date dependencies.

The researchers found that projects with automated pull requests made 60 percent more of the necessary upgrades than projects that didn’t use incentives.

“We also found that the majority of automated pull request projects were using the most up-to-date versions of dependent software, whereas the unincentivized projects were all over the map,” Parnin says. “The take-home message here is that we have automated tools that can help programmers keep up with upgrades. These tools can’t replace good programmers, but they can make a significant difference. However, it’s still up to programmers to put these tools in place and make use of them.”

The paper, “Can Automated Pull Requests Encourage Software Developers to Upgrade Out-of-Date Dependencies?” was presented at the IEEE / ACM International Conference on Automated Software Engineering, Oct. 30 - Nov. 3 at the University of Illinois at Urbana-Champaign, Ill. Lead author of the paper is Samim Mirhosseini, an undergraduate at NC State. Mirhosseini’s work on the project was supported by a Research Experience for Undergraduates grant from the National Science Foundation.



Photo credit: Missouri National Guard

Creating a virtual world-building machine for military training

The U.S. Army uses virtual simulation environments to train its soldiers in how to respond to a wide variety of situations, but building each of those scenarios from scratch is both expensive and time consuming. However, customized virtual worlds to address any training scenario may be right around the corner.

A cooperative agreement between the Army Research Laboratory and computer science researchers at NC State aims to develop a program for generating customizable virtual training scenarios. They call the program DeepGen.

“Our goal is to improve the quality and reduce the cost of these training tools, in order to help soldiers develop the skills they need to stay alive and accomplish their objectives on the battlefield,” says Dr. James Lester, Distinguished Professor of Computer Science and principal investigator on the DeepGen project.

“In addition to creating scenarios, we want to make DeepGen dynamic,” says Dr. Bradford Mott, a senior research scientist in CSC involved with the project. “We want DeepGen to create scenarios that not only incorporate targeted learning objectives, but reflect the strengths and weaknesses of individual trainees, based on each trainee’s demonstrated competencies up to that point.”

The scenarios created by DeepGen will be run on the existing “Virtual Battlespace 3” platform, which was developed by Bohemia Interactive Simulations and is already in use by the Army.

Initially, the researchers will focus on having DeepGen generate scenarios to train Army personnel on how to call in artillery fire.

To that end, the researchers are collaborating with a company called Intelligent Automation Inc. to determine which variables need to be addressed in the relevant scenarios – weather, visibility, physical environment and so on.

“The DeepGen system will also continue to grow and change over time, using a machine learning technique called deep reinforcement learning to improve the scenarios it creates based on how trainees interact with each scenario,” says Dr. Jonathan Rowe, a research scientist on the NC State computer science team.

“We’ll begin the process by running groups of virtual trainees through scenarios produced by the system, then through a group of what will essentially be beta testers,” Rowe says. “But the process will continue even after it’s in day-to-day use as a training tool. It will only get better.”

CSC online program moves up in rankings

NC State’s online graduate program in computer science moved up two spots to No. 4 on this year’s *U.S. News & World Report* list of the top computer information technology programs, making it one of the highest ranked programs at the university.

The rankings are based on a combination of factors, including student engagement, admissions selectivity, peer reputation, faculty credentials and student services and technology.

Dr. George Rouskas, director of graduate programs in the department and a professor of computer science, says the online degree program appeals to nontraditional students and mid-career adults seeking new skills.

“Our online courses are identical to our on-campus courses,” he says. “We try to make it possible for nontraditional students to take courses but we don’t water down the quality of the courses or our admissions criteria. The students appreciate that.”

EXCEPTIONAL EXPERIENCE

Dr. Linda Krute, director of distance engineering education, says NC State was a pioneer in the development and delivery of distance education courses, beginning in

the late 1970s. That history continues to pay dividends, she notes, with NC State’s online graduate engineering program ranked ninth in the nation for the second year.

“We now offer 16 online degree programs that allow students to complete their degrees from anywhere in the world,” she says. “Because of the length of time we’ve been in the distance education business, our faculty and departments are committed to delivering an exceptional experience for our online students.”

Dr. Douglas Reeves, associate dean of graduate and international programs in the College of Engineering, says distance education is becoming increasingly important in higher education and many of the nation’s top institutions are making a substantial effort to develop their reputations for online degrees.

“Certainly, one of the qualities we take real pride in is that our distance education courses are extensions of our on-campus courses. They are taught by the same faculty, at the same time, with the same standards, and often allow on-campus and distance-education students to work with each other in the class,” he says. “There is nothing second class about our distance students or the way we teach those courses.”

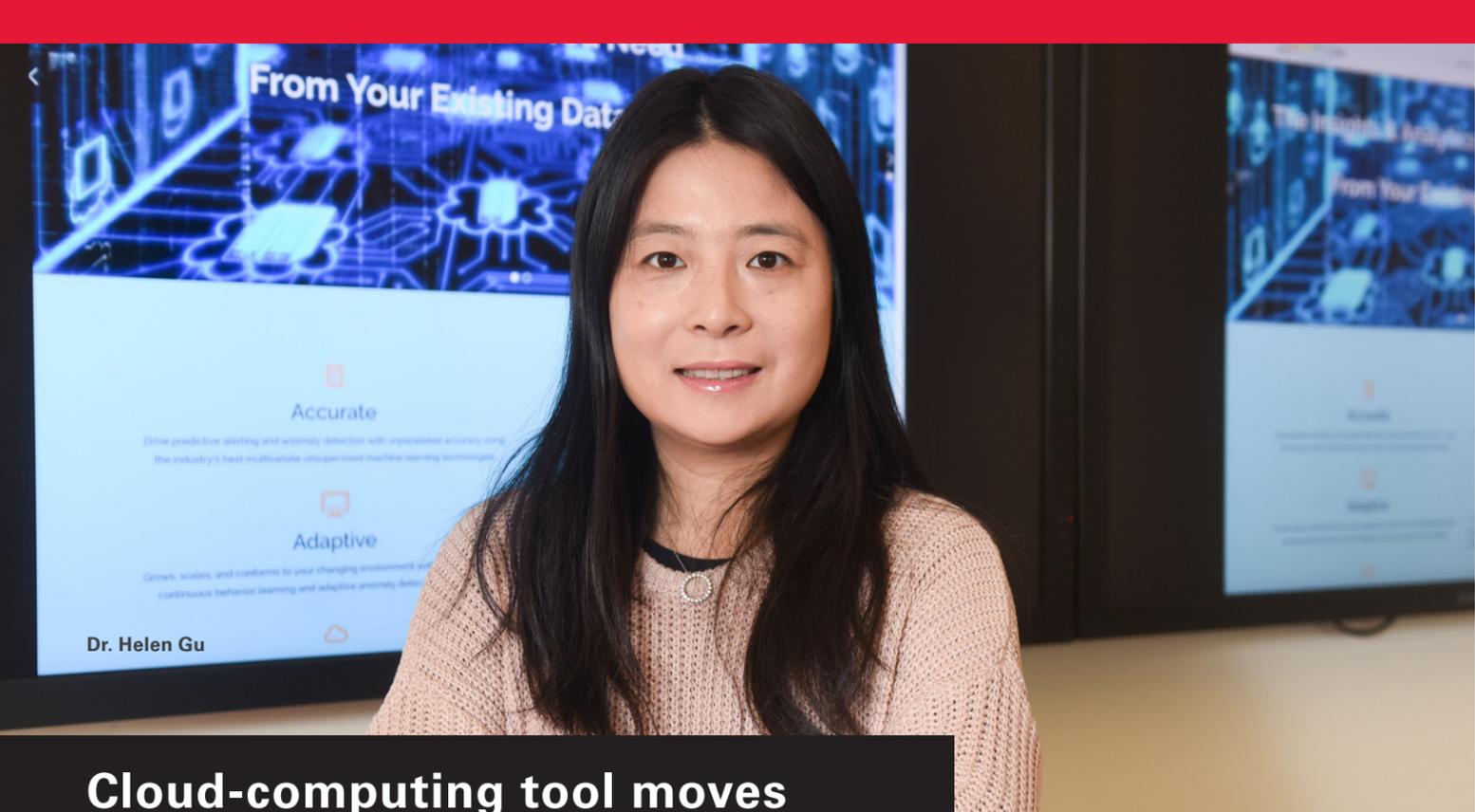
Seven new members to join department’s SAB

The Computer Science Department is pleased to welcome seven new members to the department’s Strategic Advisory Board (SAB):

- **Reba Barber:** Manager of global IT technical architecture at Eastman
- **Betsy Brady:** SVP, global information security at Bank of America
- **Dan Corgan:** SVP and cyber threat intelligence officer at BB&T
- **Greg DeKoenigsberg:** Director of Ansible Community at Red Hat
- **Matt Griffin:** Senior director, technology at Capital One and NC State alumnus
- **David Hurry:** Executive director of computer science at Merck
- **Jeff Pfeifer:** Vice president of product management and Raleigh Technology Center site lead at LexisNexis

The SAB is a group of industry executives and academic leaders who play critical roles in shaping the department’s vision and strategic focus. The group is the foundation of the department’s strategic planning efforts that is an essential part of the department. They meet annually on campus and act as a virtual working team through member involvement on subcommittees, executive panels, and other engagement opportunities. Each term with the SAB group is three years and membership may be renewed for a second term.

Monique Morrow, president and co-founder of The Humanized Internet, is currently the chair of the SAB, and Joe Bastante, vice president of enterprise architecture and strategy at Blue Cross Blue Shield of North Carolina, is vice-chairperson.



Cloud-computing tool moves from the lab to the marketplace

It's always exciting for scientists to see their ideas come to fruition in the lab. For NC State computer science researcher Dr. Helen Gu, that idea was a new approach to identifying and preventing cloud-computing problems. And her idea has now expanded beyond the lab, as the company she launched – InsightFinder Inc. – has now grown into an enterprise with a dozen employees, a growing client list, and a bright future.

"We are now working with 15 companies around the world that rely on cloud-computing technologies, in sectors from healthcare to finance to telecommunications," Gu says. "Essentially, we are helping clients – from Fortune 500 companies to small startups – identify problems before they affect performance and service availability. And we not only identify the problems, but diagnose what is causing them, so that they can be addressed."

InsightFinder builds off of a system called Unsupervised Behavior Learning (UBL), which Gu and Dr. Daniel Dean (a former Ph.D. student in Gu's lab and now vice president of analytics at InsightFinder) first presented in 2012. The UBL technology allows companies that use cloud computing to gain insight into user and program behavior in order to diagnose potential problems in their code. The technology can also prevent performance disruptions in cloud-hosted applications by automatically identifying and responding to potential anomalies before they can develop into service outages.

But the technology has changed a great deal over the past six years.

"For example, we have now incorporated automated processes that can begin taking steps to address potential problems as quickly as they are identified," Gu says. "We're talking about a matter of seconds between seeing a problem and responding."

NC State's Office of Technology Commercialization and New Ventures filed for a patent on the technology in 2013, and Gu launched InsightFinder two years later.

InsightFinder got an early boost from the National Science Foundation, which awarded her a Small Business Innovation Research (SBIR) grant in 2015. And the NC State startup was awarded a highly competitive Phase II SBIR grant in 2017.

"The SBIR grants have been incredibly important," Gu says. "Without that support, the company would not have been possible. We've now closed on more than \$2 million in funding. Proceeds will be used to expand teams in sales, marketing, and customer support."

"NC State has been a wonderful launching pad for us," Gu says. "The Office of Technology Commercialization and New Ventures has been extremely supportive and helpful. And, in the company's early days, NC State's Daugherty Endowment was crucial in providing the seed money we needed to grow."

New center tackles analytics challenges

Faster than life analytics is a way of looking at the leading edge of a smart data revolution, pushed by advances in Internet-based sensor hardware, diverse streams of continuous data, and new hardware platforms supporting accelerated Artificial Intelligence and Machine Learning. Extracting value from massive and moving data hinges on balancing fundamental research, technological know-how, and commercial market intelligence.

In response to this need, The National Science Foundation (NSF) Industry-University Cooperative Research Centers (IUCRC) program recently selected the University of Maryland Baltimore County (UMBC) to lead the new Center for Accelerated Real Time Analytics (CARTA). Partnering with North Carolina State University, Rutgers University New Brunswick, and Rutgers University Newark along with a diverse group of industry partners, CARTA will visualize and address the future advanced, real-time analytics needs of industry and society. Dr. Rada Chirkova, professor of computer science, will be the director of the NC State University site (CARTA/NC State). Dr. David Wright, director for project management in the department, will serve as the associate director.

Realizing that the whole of CARTA can be more than the simple sum of its member institutions, the Center will actively encourage multi-institutional and multi-disciplinary research projects. Each of the member institutions bring their own specializations that, when combined, have capabilities far beyond their individual abilities. Indeed, solving the problems of accelerated real time analytics must involve data wrangling, advanced hardware, scalable and configurable analytics algorithms, and new visualizations, each of which is an area of expertise among the member institutions.

CARTA/NC State will focus on the data-readiness and data-value needs of "faster than life" analytics. The new paradigm of analytics where heterogeneous data and knowledge are collected and aligned across boundaries of organizations in one way for one purpose, and then reorganized and realigned across

the boundaries of other organizations for a different purpose is becoming more and more common.

A common thread of the research needs and problems resulting from this new paradigm is that of "data readiness" and "data value." The challenge is to enable productive, efficient, and secure end-to-end value extraction from the data given specific analytics tasks and constraints on the availability and structure of the incoming data. Facets of this challenge include identifying appropriate technologies for: storing and cleaning the data; modeling the data; making the data secure; asking the right analysis questions; pre- and post-processing the data with regard to the analysis; and finally, making the analysis results useful.

IUCRCs are nationwide research centers organized to

address pre-competitive research areas that have been identified as national priorities. They represent long-term partnerships among universities, industry and government that leverage an investment from NSF to catalyze primary support from the public and private sectors. The five-year NSF award to establish CARTA at the four institutions will be for \$3 million, split among the four partner institutions. The NSF support for CARTA initiatives is expected to be multiplied several-fold by memberships

and direct project support provided from the private and public sector.

The nationally unique focus of CARTA will be to develop broad, foundational analytics technologies that will create an infrastructure capable of powering applications of national significance. CARTA research will visualize and address the advanced, real-time analytics needs of industry and society now and in the future. The techniques developed by CARTA will have applications across industry sectors, including national security, healthcare, manufacturing, transportation, energy, and business intelligence, delivering practical solutions to hard problems.

For more information, please see www.carta.ncsu.edu.



Dr. Rada Chirkova (left), and Dr. David Wright



Department launches Alumni Hall of Fame

As part of the department's 50th Year celebrations, the Computer Science Alumni Hall of Fame was officially launched during a special ceremony held at the Park Alumni Center on Thursday, October 12th, 2017. The event was attended by more than 120 faculty and staff members, award winners and their families and special guests.

The CSC Alumni Hall of Fame was established to celebrate and recognize the exemplary contributions our outstanding graduates have made to their profession, their community, and to the world at large.

Award winners were presented a specially designed award to take home and they will be featured on a permanent display wall on the 3rd floor of Engineering Building II, near the department's main office. The wall features an interactive component that is also accessible online at ncsucsc.touchpros.com/SearchBy.aspx.

The 2017 CSC Alumni HOF inaugural class consisted of 25 highly accomplished alumni inductees:

- Alen D. Baker (B.S. '73) - Retired Duke Energy executive; president emeritus, NC Wildlife Federation
- Marshall Brain II (M.S. '89) - Author, TV personality, founder of HowStuffWorks franchise, 2011 NC State Distinguished Engineering Alumnus
- David Burke (B.S. '04) - Director of cyberwarfare for Naval Aviation
- Keith Collins (B.S. '82) - EVP & CIO, SAS Institute; 2003 NC State Distinguished Engineering Alumnus
- Jeff Crume (B.S. '84) - Author and security expert, distinguished engineer & executive IT security architect, IBM
- Chris Crump (B.S. '78) - Retired Silicon Valley executive
- Brenda Crutchfield (M.S. '89) - Deputy director of future operations, US Army Cyber Command
- Nirmitt Desai (M.S. '03, Ph.D. '08) - Research staff member, IBM and creator of Mesh Network Alerts
- Suzanne Gordon (B.S. '75) - Retired SAS Institute

- executive, former member of NC State Board of Trustees
- Larry Hodges (M.S. '82, Ph.D. '88) - Virtual reality expert and professor of human-centered computing, Clemson University
- Richard Holcomb (M.S. '89) - Serial entrepreneur
- Bobby R. Johnson Jr. (B.S. '77) - Co-founder and former CEO, Foundry Networks, 2008 NC State Distinguished Engineering Alumnus
- Martin Loy (B.S. '87) - Senior director, Security Trust Engineering, Cisco Systems
- Elizabeth Mynatt (B.S. '88) - Expert in ubiquitous computing, human-computer interaction, and assistive technologies, distinguished professor; executive director, Georgia Tech Institute for People and Technology
- Raif Onvural (M.S. '85, Ph.D. '87) - President and CEO, Telehealth & Telemedicine, Inc.
- Gerhard Pilcher (B.S. '85, MSA '11) - President and CEO, Elder Research
- Rudy Puryear (B.S. '74) - Partner and director, Bain & Company IT practice
- Troy Tolle (B.S. '98, MS '00) - Co-founder and CTO, DigitalChalk, Inc.
- Erik Troan (B.S. '89) - Serial entrepreneur
- Donna Troy (B.S. '78) - Retired EVP and general manager, Epicor Software
- Bill Weiss (B.S. '76) - Chairman and CEO, The Promar Group
- Ed Whitehorne (B.S. '72) - Chairman of the board, FHI 360
- Josh Whiton (B.S. '04) - Founder and former CEO, TransLoc, Inc.
- Gary Williams (B.S. '74) - Former Milliken & Company executive
- Pinar Yolum (M.S. '00, Ph.D. '03) - Entrepreneur and professor, Bogazici University

In addition, the department recognized six Outstanding Young Alumni:

- Bushra Anjum (Ph.D. '12) - International academician, author, technical lead and software development engineer, Amazon
- Sina Bahram (B.S. '07, M.S. '10) - Presidential 'Champion of Change' honoree; president, Prime Access Consulting, Inc.
- Khalia Braswell (B.S. '13) - User experience engineer, Apple, Inc.; founder and executive director, INTech Foundation, Inc.

- KaMar Galloway (B.S. '13) - Program manager, 'CS First' Program, Google, Inc.
- Sarah Heckman (B.S. '04, M.S. '05, Ph.D. '09) - Teaching associate professor and assistant director of CSC undergraduate programs, NC State University
- Vidya Srinivasan (M.S. '11) - Program manager, SharePoint and Office 365, Microsoft, Inc.

Dr. Laurie Williams, interim department head, says, "This is an exceptional group of individuals who have all, in some way or another, impacted our lives in a very positive way." She adds, "By recognizing our most distinguished alumni, we hope they will serve as an inspiration for current and future students."

Ken Tate, director of engagement and external relations, says the inaugural class is very special. "We had about 50 nominations and they were all outstanding candidates, but the 25 inaugural inductees were all unanimous selections by the selection committee. They represent the very best of the best," says Tate. But he adds, "With more than 9,000 alumni scattered all over the globe, we don't know about everyone's accomplishments."

The auspicious occasion was made possible thanks to the generous support of sponsors, **SAS, Dude Solutions, the ePartners Program** and the **NC State Engineering Foundation**.

Photos of the event can be found at www.flickr.com/photos/cscncsu/sets/72157687480616430.

To nominate someone for future consideration, please visit www.csc.ncsu.edu/alumni/hall-of-fame.php.





Department marks 50th anniversary with events

The department celebrated its 50th anniversary in fall 2017. Along with the inaugural Alumni Hall of Fame induction ceremony on October 12th (see story on page 12), CSC held several educational and engaging events in the month of October.

- CSC took advantage of the national spotlight pointed on Raleigh on Thursday, October 5th, when the Wolfpack football team hosted the Louisville Cardinals in a nationally televised game on ESPN.

The **department's game sponsorship** included a special ad in the game program, quarterly recognition on the video and ribbon boards, a pre-game radio interview, an "on-field" recognition during the 1st half, radio commercials and live in-game liners when NC State passed the 50 yard line for the first time each half. The department had a special booth in the Fan Zone, where student ambassadors and staff members handed out special 50th year giveaways. The game was co-sponsored by ePartners **IBM** and **Fidelity Investments**.

To top things off, the Wolfpack came away with a convincing 39-25 victory.

- On Wednesday, October 11th, a **50th Year "Centennial Rocks" concert** was held featuring the amazing sounds of Bull City Syndicate, a 10-piece band that covers hits from the 60s to today.

Attendees enjoyed plenty of free food and adult beverages, as well as games and giveaways. This event was powered by the NC State Office of Partnerships and Economic Development in collaboration with CSC, and was proudly sponsored by **Eastman Chemical, Cisco,** and **Pendo**.

- A very special day-long 50th Year Technical Symposium and Reception at the James B. Hunt Jr. Library on Centennial Campus on Friday, October 13th, highlighted all of the amazing achievements that have come out of CSC in the first 50 years and what is coming next.

During a morning panel discussion, faculty members and alumni provided a retrospective look at the department's history. After a catered lunch of traditional North Carolina BBQ and fried chicken, guests had an opportunity for guided tours of the Hunt Library and Engineering Building II. In the afternoon session, a variety of futurists presented a vision of what's to come, and how computer science will need to evolve over the next 50 years.

Speakers for the afternoon included Patrick McDaniel – a distinguished professor and renowned security expert from Penn State University, Alvy Ray Smith – a pioneer in the field of computer graphics and animation and co-founder of Pixar Studios, and Brian David Johnson – renowned futurist, technologist and author, currently the Futurist in Residence at Arizona State University.

The symposium was followed by a special 50th Year reception. The special day was made possible thanks to the generous sponsorship of **Capital One, BCBS of NC, LexisNexis, Dell EMC, Fidelity Investments, LabCorp, Merck, NetApp, Oracle, Premier, Red Hat,** and **Allscripts**.

- On Friday, October 20th, the grassy Engineering Oval was transformed into a giant movie theater for the **50th Year Movie on the Oval**. Everyone was invited to bring blankets and lawn chairs and enjoy a special viewing of "The Imitation Game" on a big screen under the stars.

The film, which tells the story of how British mathematicians cracked the German Enigma code during World War II, was a particularly good choice for computer science students and faculty members.

Moviegoers enjoyed free pizza, NC State Howling Cow ice cream, popcorn and sodas as the sun set.

50th Year Movie on the Oval was sponsored by **Capital One and VMware**.

Kremer joins CSC staff as director of development

The Department of Computer Science is extremely excited to announce the addition of Kyle Kremer as director of development, a new role in which he will be responsible for engagement and major gift cultivation for the department's more than 9,000 alumni.

Kremer, a member of the NC State Engineering Foundation staff, will retain his current role as director of development for the Department of Materials Science and Engineering, while expanding to also cover computer science alumni.

"We are very excited to have Kyle join our team," says interim department head Dr. Laurie Williams. "Kyle is a highly accomplished major gifts officer with a strong track record of helping donors make an impact in a way that is meaningful to them, while transformational to the organization. We look forward to having him get to know our incredible alumni, and help them discover how they can make a difference in the life of our department."

Ken Tate, director of engagement and external relations, says that Kremer's addition allows for an expansion of the external relations function. "Our department is larger than several colleges here at NC State, and we have alumni in all 50 states over 20 countries. About 10 percent of our alumni are in the Silicon Valley area alone," says Tate. "Having a dedicated development officer, especially someone as accomplished as Kyle, will allow us to engage with more of our alumni than ever before."

Kremer is a 2009 graduate of Bowling Green State University. He joined NC State in March 2017 as director of development for the Department of Materials Science and Engineering. Prior to that, he was associate director of annual giving for The Fuqua School of Business at Duke University.





Dr. Laurie Williams

WILLIAMS ELECTED AS FELLOW OF IEEE, APPOINTED AS DISTINGUISHED PROFESSOR

Dr. Laurie Williams, interim head of the department and a co-director of the Science of Security Lablet at NC State, has received two recent significant honors.

Williams has been elected as a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). She has also been named a Distinguished Professor of Computer Science by Engineering Dean Dr. Louis A. Martin-Vega.

The IEEE Fellow is one of the most prestigious honors of the IEEE and is bestowed upon a very limited number of Senior Members who have contributed importantly to the advancement or application of engineering, science and technology bringing significant value to the society.

Williams, who joined the NC State faculty in 2000, was recognized by IEEE for her contributions to reliable and secure software engineering.

Williams is internationally known as one of the foremost researchers in agile software development and the security of healthcare IT applications. Additionally, she leads the Software Engineering Research research group at NC State, which focuses on the development of reliable, secure software and collaboration with high-tech companies such as ABB Corporation, Cisco, IBM, Microsoft, Nortel Networks, Red Hat and numerous healthcare IT organizations.

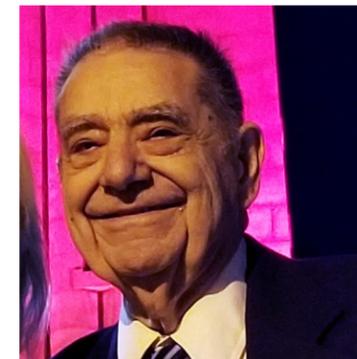
She has received many accolades and awards throughout her career, including:

- NSF CAREER Award (2004)
- NC State Outstanding Teaching Award (2006)
- NC State Academy of Outstanding Teachers (2006)
- ACM SIGSOFT Influential Educator Award (2009)
- ACM Distinguished Scientist (2011)
- NC State University Faculty Scholar (2013)
- IEEE Senior Member (2015)
- NC State Research Leadership Academy (2016)
- NC State Alumni Association Outstanding Research Award (2016)
- Microsoft Research Outstanding Collaborator Award (2016)

Williams' research focuses on software security particularly in relation to healthcare IT; agile software development practices and processes, particularly continuous deployment; and software reliability, software testing and analysis. She has more than 230 refereed publications.

Williams received her Ph.D. in computer science from the University of Utah, her MBA from Duke University Fuqua School of Business and her B.S. in industrial engineering from Lehigh University. She worked for IBM Corporation for nine years in Raleigh, NC, and Research Triangle Park, NC, before returning to academia.

BITZER INDUCTED INTO NATIONAL ACADEMY OF INVENTORS



Dr. Donald L. Bitzer

Dr. Donald L. Bitzer, Distinguished University Research Professor of Computer Science, has been named a Fellow by the National Academy of Inventors (NAI).

The academic inventors and innovators elected to the rank of NAI Fellow are named inventors on U.S. patents and were

nominated by their peers for outstanding contributions to innovation in areas such as patents and licensing, innovative discovery and technology, significant impact on society, and support and enhancement of innovation.

The 2017 class of Fellows – which also included Dr. William Ditto, professor of physics at NC State – was inducted on April 5, 2018, as part of the Seventh Annual Conference of the National Academy of Inventors at the Mayflower Hotel, Autograph Collection in Washington, D.C.

Bitzer co-invented the flat plasma display panel in 1964. The technology was eventually applied to television screens, and millions of plasma TVs have been sold to the public since they were introduced in the 1990s. His work on the plasma display monitor earned him an Emmy Award in 2002. He also invented and co-developed Programmed Logic for Automated Teaching Operations, or PLATO, the first computer system to combine graphics and touch-screen displays.

More than a hundred family members, friends and professional colleagues gathered at The Point (the Chancellor's mansion) on the evening of May 8th to celebrate Bitzer's induction. As the sun set in Raleigh on this beautiful evening, the NC State Memorial Belltower was bathed in red in honor of Bitzer's achievements.

Bitzer and Ditto join seven other NC State faculty members who have previously been named NAI fellows: David Aspnes, Distinguished University Professor of Physics; B. Jayant Baliga, Distinguished University Professor of Electrical Engineering; Ruben Carbonell, Frank Hawkins Kenan Distinguished Professor of Chemical Engineering; Jerome Cuomo, Distinguished Research Professor of Materials Science and Engineering; Frances S. Ligler, Lampe Distinguished Professor in the UNC / NC State Joint Department of Biomedical Engineering; Jay

Narayan, John C.C. Fan Distinguished Chair Professor of Materials Science and Engineering, and Franky So, Walter and Ida Freeman Distinguished Professor of Materials Science and Engineering.

The NAI is a 501(c)(3) non-profit member organization comprising U.S. and international universities, and governmental and nonprofit research institutes, with over 3,000 individual inventor members and Fellows spanning more than 240 institutions, and growing rapidly. It was founded in 2010 to recognize and encourage inventors with patents issued from the U.S. Patent and Trademark Office, enhance the visibility of academic technology and innovation, encourage the disclosure of intellectual property, educate and mentor innovative students, and translate the inventions of its members to benefit society.



Dr. Xipeng Shen

SHEN NAMED 2017-2018 UNIVERSITY FACULTY SCHOLAR

Dr. Xipeng Shen, associate professor of computer science, has been named to the 2017-2018 class of NC State University Faculty Scholars. The 20 recipients represent early- and mid-career faculty members dedicated to serving

the university community and their respective fields through scholarship, research and engagement.

The University Faculty Scholars program, established by the chancellor in 2012, recognizes and rewards emerging academic leaders at NC State. So far 126 faculty have received this honor. Faculty members selected as University Faculty Scholars carry the title for the duration of their faculty appointment at NC State and receive an increase to their base salary.

A committee of senior faculty reviews nominations submitted by the colleges. Assistant professors appointed for a second term, all associate professors and professors within the first three years of appointment at that rank may receive nominations. The committee evaluates nominees on their research and scholarship productivity, excellence in teaching and mentoring, and leadership in extension, professional societies and public service initiatives.

Shen joined the NC State faculty August 2014 as a Chancellor's Faculty Excellence Program cluster hire in Data-driven Science. He is also an adjunct associate professor in the

Department of Electrical and Computer Engineering.

His research lies in the broad fields of Programming Systems and Machine Learning, with an emphasis on enabling extreme-scale data-intensive computing and intelligent portable computing through innovations in compilers, runtime systems, and Machine Learning algorithms. His current research focuses on Heterogeneous Massively Parallel Computing, High Performance Machine Learning, and High-Level Large-Scale Program Optimizations.

Prior to joining NC State, Shen was the Adina Allen Term Distinguished Associate Professor in the Computer Science Department at The College of William and Mary. He was a Visiting Researcher at M.I.T., Microsoft Research, and Intel Labs between 2012 and 2013, and an assistant professor at The College of William and Mary from 2006 to 2012.

His research in data locality for exascale computing won the prestigious Early Career Research Award from the U.S. Department of Energy in 2011. His research in input-centric program dynamic optimizations won the CAREER Award from the National Science Foundation in 2010.

Shen received his Ph.D. and M.S. in computer science from University of Rochester, his M.S. in pattern recognition and intelligent systems from Chinese Academy of Sciences, and his B.E. in industrial engineering from North China University of Technology.



Dr. George Rouskas

**ROUSKAS NAMED
2018 ALUMNI
DISTINGUISHED
GRADUATE
PROFESSOR**

Dr. George Rouskas, director of graduate programs and professor in the department, has been recognized as an Alumni Association

Distinguished Graduate Professor for 2018.

The selection committee was unanimous in its praise of Rouskas' exceptional record of promoting and supporting multiple facets of graduate education at NC State.

Particularly impressive were the letters from the students themselves, which attest to the extraordinary quality of mentoring that he provided both during and after their graduate programs at NC State.

Rouskas, who joined the department in 1994, is the author of the monograph "Internet Tiered Services: Theory,

Economics and Quality of Service" (Springer, 2009), co-editor of the book "Next-Generation Internet: Architectures and Protocols" (Cambridge University Press, 2011), and co-editor of the book "Traffic Grooming for Optical Networks: Foundations, Techniques and Frontiers" (Springer, 2008).

He currently serves as editor-in-chief of IEEE Networking Letters and as a steering committee member of the OFC conference. He co-founded and served as co-editor-in-chief of the Elsevier journal *Optical Switching and Networking* from 2004-17. In 2016-17, he served as chair of the IEEE Communications Society Distinguished Lecturer Selection Committee, as chair of the Optical Networking Technical Committee (ONTC), and as vice-chair of the IEEE Communications Society Technical and Educational Activities Council. As an IEEE distinguished lecturer in 2010-11, he completed four tours in the U.S., Caribbean, and Sri Lanka. He was the TPC or general chair for: NETWORKS 2018, IEEE MASS 2018, IEEE ICC ONS 2017, IEEE ICNP 2014, ICCCN 2013 and 2011, IEEE GLOBECOM ONS 2010, BROADNETS 2007, IEEE LANMAN 2005 and 2004, and IFIP NETWORKING 2004.

Rouskas was elected a Fellow of the IEEE in 2012 for his "contributions in algorithms, protocols, and architectures of optical networks." His many other awards include an IEEE GLOBECOM Outstanding Service Award (2010), an IBM Faculty Partnership Award (2007), an ALCOA Foundation Engineering Research Achievement Award (2004, NC State College of Engineering), an Alumni Outstanding Research Award (2003, NC State), an NSF CAREER Award (1997), an Outstanding New Teacher Award (1995, NC State Department of Computer Science). And he was inducted in the NC State University Academy of Outstanding Teachers in 2004.

As of 2018, 24 Ph.D. students and 12 master's thesis students have graduated under Rouskas' supervision. His research interests are in the broad field of computer networking — specifically, optical networks, Internet architectures and protocols, network design and optimization, performance modeling, and scheduling.

Rouskas earned his Ph.D. and master's degree in computer science from the Georgia Institute of Technology, and his B.S. in computer science from The National Technical University of Athens, Greece.

**HECKMAN NAMED 2018 ALUMNI DISTINGUISHED
UNDERGRADUATE PROFESSOR**

Every year, the NC State Alumni Association honors faculty members who excel in the classroom, laboratory and in the field. Dr. Warwick Arden, NC State executive vice chancellor and provost, recently announced that Dr. Sarah Heckman, teaching associate professor and assistant director of undergraduate



STOLEE WINS NSF CAREER AWARD

Dr. Kathryn Stolee, assistant professor in the Department, has received a Faculty Early Career Development award from the National Science Foundation (NSF). The award, known as the NSF CAREER Award, is one of the highest honors given by NSF to young faculty members in science and engineering.

NSF will provide \$500,000 in funding over five years in support of her project, "On the Foundations of Semantic Code Search." This research is supported by NSF's Division of Computing and Communication Foundations.

Stolee's research uses semantic code search to help developers find code for reuse or for repairing broken code. Semantic code search finds code based on behavior, described using input/output examples. The engine behind the search is a constraint solver; code fragments (e.g., methods, blocks) are indexed using symbolic analysis to obtain a constraint representation of the code behavior. Given input/output examples and constraints for a code fragment, the solver determines if the code satisfies the specification.

Stolee's project lays the foundation for semantic code search to be applied in broader contexts and to a wide range of developers. It addresses issues that arise when programmers use semantic code search to find code to reuse during software development. Challenges arise when 1) the desired code does not exist; 2) there are too many results to navigate efficiently; or 3) it is difficult to differentiate between similar code snippets. These challenges are especially pronounced for programmers in

languages that are less supported, such as those used by end-user programmers.

To address the challenges, this research develops novel techniques to 1) find approximate solutions to semantic queries; 2) enable richer query models; 3) use the constraints to characterize the differences and similarities in behavior between code snippets; and 4) efficiently navigate the space of potential solutions. Through addressing the fundamental challenges facing semantic code search, Stolee's research will extend the applications that benefit from search to also include cross-language clone detection and refactoring verification. It will allow more precise code specification and make semantic search more performant. It will enable semantic code search to operate in a constrained environment with low quantities of existing code. Finally, it is aligned with her overall career goals to make programming easier and more accessible, and to bring the benefits of software engineering analyses and techniques to the millions of end-user programmers and professional programmers.

Stolee's research interests are in software engineering, program analysis, code search, empirical studies and program repair.

She received her B.S., M.S., and Ph.D. degrees in computer science from the University of Nebraska-Lincoln. Stolee was the Harpole-Pentair Assistant Professor of Software Engineering at Iowa State University from 2013–15 before starting at NC State as an assistant professor of computer science in January 2016.



Dr. Sarah Heckman

programs in CSC, has been selected as a recipient of an Alumni Distinguished Undergraduate Professor Award for 2017-18.

Heckman, a three-time graduate of the department (B.S. in 2004, master's in 2005, and Ph.D. in 2009), is the department's first teaching associate professor. She received

the NC State University Outstanding Teacher Award and the Alumni Association Outstanding Teacher Award in 2015. She is a member of the Academy of Outstanding Teachers at NC State, and in 2017 was presented with an NC State Computer Science Outstanding Young Alumni Award.

Heckman's research interests are in computer science education and software engineering – specifically skill transfer and automated feedback.

The Alumni Distinguished Undergraduate Professor Award, coordinated by the Office of the Executive Vice Chancellor and Provost and the Office of Faculty Development, is one of the most prestigious awards given on campus. Winners are recognized at the Alumni Faculty Awards Reception, a ceremony designed to celebrate faculty dedication to NC State's core values – teaching, research, and extension.



Dr. Jason King

KING RECEIVES GERTRUDE COX AWARD FOR TEACHING WITH TECHNOLOGY

Dr. Jason King, teaching assistant professor in the department, has received the Gertrude Cox Award for Innovative Excellence in Teaching and Learning with Technology. The award was presented to

two individual faculty members, and a team of faculty and staff members and postdoctoral scholars.

The award, first given in 2002, honors the creative pedagogy of NC State's faculty members and technical staff and their work in integrating new technologies into effective teaching strategies. Gertrude Cox, "The First Lady of Statistics" and the award's namesake, came to NC State in 1940 to establish the university's distinguished Department of Statistics.

King is a three-time graduate of the NC State Department of

Computer Science (B.S. 2009, M.S. 2011, and Ph.D. 2016). His research focuses on computer science education and software security. His current research explores tools and educational practices for helping novice developers connect data structure and algorithm theory with software engineering practice, as well as tools and practices for proactively building security into software from the beginning of the development lifecycle.



Tammy Coates

COATES RECOGNIZED FOR SUPPORT OF WMEP FACULTY/STAFF OUTREACH

Tammy Coates, assistant director of external relations in the department, has been recognized as the College of Engineering's Most Supportive Staff Member for Women and Minority

Engineering Programs (WMEP) Faculty/Staff Outreach. The award was presented during the 2018 Annual Engineering Awards Reception on April 24.

The Most Supportive Staff Member Award is presented to the staff member who supports WMEP students in a way that makes them feel welcomed, valued and appreciated. This person helps students navigate day to day challenges throughout their collegiate experience.

Per Coates' nomination, "Tammy works tirelessly and is a behind-the-scenes force for students, faculty and staff members. She has given an unwavering hand in planning, supporting, and making sure that everything is in place for meetings, summer camps, workshops, and other events. She is that 'go to' person when you want to get things done because when you make a request of her, she will make sure that you have what you need for your program to be a success."

For more information on the College of Engineering's Women and Minority Engineering Programs, visit www.engr.ncsu.edu/wmep.



Dr. Min Chi

CHI RECEIVES ALCOA FOUNDATION ENGINEERING RESEARCH AWARD

Dr. Min Chi, assistant professor in CSC, received a 2018 Alcoa Foundation Engineering Research

Award during the College of Engineering's spring faculty meeting.

Chi was awarded the Alcoa Foundation Engineering Research Achievement Award, which recognizes young faculty members who have accomplished outstanding research achievements during the preceding three years.

Chi's research has helped pioneer the use of techniques from Reinforcement Learning to improving the decision making of Intelligent Tutoring systems. Her research addresses both how we should induce effective pedagogical strategies and how to empirically evaluate the resulting policies to improve educational outcomes. In the last three years, she has greatly expanded this line of research by exploring more advanced feature selection methods and learning algorithms including Deep, Hierarchical, and Constrained Action-based Reinforcement Learning. In the past three years, she has had 19 publications in refereed conference proceedings, several of which earned additional recognition: an Outstanding Paper Award at the International Conference of User-Modeling and Adaptive Personalization in 2016, a Best Paper Award at Data and Applications Security and Privacy XXIX (DBSec2015) in 2015, and two Best Paper Award Finalist designations at the International Conference on Educational Data Mining (EDM) in 2015 and 2017. She also published two journal articles. She has received more than \$5.8 million in support from five National Science Foundation grants on which she was PI or co-PI since January of 2015, including a prestigious CAREER award.

Dr. Jason Haugh, professor in the Department of Chemical and Biomolecular Engineering, received the Alcoa Foundation Distinguished Engineering Research Award, made to a senior faculty member for research achievements over a period of at least five years at NC State.



Ken Tate

TATE WINS INAUGURAL PERSON OF EXCEPTIONAL PERFORMANCE AWARD

The department has presented the inaugural Person of Exceptional Performance or PEP Award to Ken Tate, director of engagement and external relations.

In the fall of 2017, Tate led an extended team that planned and executed the celebration of the department's 50th anniversary. Events and activities included a special "Centennial Rocks" retro concert, an outdoor "Movie on the Oval" evening featuring the CSC-

themed movie — "The Imitation Game," and a highly successful Technical Symposium and reception. He also orchestrated the sponsorship of a special Thursday night ACC showdown between Louisville and NC State football game featured on ESPN. This included a pregame radio interview, program ads, in-game announcements and an on-field presentation that helped promote the department. Also part of the 50th year celebrations was the creation of a special 50th year publication and an update of the department's history document. He also leveraged the 50th year celebrations to launch the department's CSC Alumni Hall of Fame, featuring an interactive recognition wall and online site. Twenty-five outstanding CSC alumni were inducted into the inaugural class at a special event held at the Park Alumni Center, along with six outstanding young alumni who were also selected for special recognition.

In addition, Tate has made a lasting impression on the department by his tireless focus on corporate partnerships and a passion for outreach. Under his leadership, the ePartners Program has grown to now include 18 Super ePartners and well over 100 different corporate partners engaged with the department at different levels. Last year, total support from the ePartner companies exceeded \$1.2 million, with a record of more than \$350K in completely unrestricted cash support. During his almost 17 years here at NC State, Tate has helped raise more than \$13 million to support the department.

From an outreach perspective, Tate has worked closely with our department's Strategic Advisory Board, industry partners, and College of Engineering Admissions for almost a decade to create a comprehensive outreach program designed to increase the attraction of females and under-represented students into the CSC discipline. His passion for outreach has led to a complete redesign of the department's Future Students page with much more focus on diversity and changing the narrative about computer science and its application in improving the human condition. The campaign has engaged more than 10,000 middle and high school math, science and technology teachers over the years, with a graphic-intensive campaign, including a dynamic Faces of Computer Science campaign. He launched the CSC Student Ambassadors program, a group of about 25 of the department's very best undergrads. This diverse group regularly supports about 700 volunteer service hours annually giving tours, hosting open house events and other visits, and engaging prospective students and their parents. This and other related campaign components have led to a 30 percent year-over-year improvement in female applicants. In 10 years, undergrad female enrollment has improved ~80 percent, increasing from about 10 percent to 18 percent. The incoming CSC class for the fall of 2018 includes 164 accepted female students, up 48 percent over last year.

STEWART RETIRES AFTER MORE THAN 40 YEARS



Dr. William J. Stewart

DR. WILLIAM J. STEWART, professor of computer science, retired this summer after serving the department for more than 40 years.

Stewart completed his undergraduate degree in applied and pure mathematics at The Queen's University of Belfast, Northern Ireland in 1970. He continued his studies at Queen's University, receiving an M.Sc. in 1971 and a Ph.D. in 1974 for a dissertation entitled "Markov Analysis of Operating System Techniques." He spent five years as a research associate at the Universite de Rennes in France before accepting a faculty position in the Department of Computer Science at NC State in 1978. In the 40 years that he spent at the University, Stewart was active in research, teaching and administration.

Stewart has been at the forefront of research into all aspects of generating, solving and analyzing Markov chains. Mathematical modeling based on Markov chains is used

extensively in determining the behavior of critical processes in the biological, physical and social sciences, as well as in engineering and business. Stewart's research has appeared in numerous journals, and his research was supported by grants from the National Science Foundation.

He was a catalyst for the many varied factions involved in Markov chain research. Beginning in 1990, he instituted a series of international conferences where researchers could meet, interact and share their different perspectives of the same problem. In particular, in 2006, he organized an international conference to honor the 150th anniversary of Markov's birth and the 100th anniversary of the publication of his seminal papers on chains.

Stewart's software package, "MARCA: MARKov Chain Analyzer," which is licensed by NC State University, assists scientists and engineers in developing and solving large scale Markov models. His book "An Introduction to the Numerical Solution of Markov Chains" is the primary reference work for solving Markov chains numerically. He has also published a graduate level textbook titled "Probability, Markov Chains, Queues and Simulation" as well as an undergraduate textbook titled "A First Course in Probability."

During his tenure at NC State, Stewart held the positions of director of Computer Science Graduate Programs for five years (1986-1991), director of the interdisciplinary graduate program Operations Research (1996-1999), and the assistant director responsible for the Computer Science Master's program.

In 1991, the NCSU Association for the Concerns of African-American Graduate Students presented Dr. Stewart with the "NCSU Advocacy Award." This is awarded annually to a dean, department head or program director for "going beyond the call of duty in promoting the presence of African Americans on the NCSU Campus."



Dr. David J. Thuente

THUENTE RETIRES AFTER 17 YEARS IN THE DEPARTMENT

DR. DAVID J. THUENTE, professor of computer science, retired June 30 after 17 years at NC State and 27 years at Purdue University – Fort Wayne. He served as director of Computer Science Graduate Programs from 2003 – 2010 and then served eight productive years as a regular faculty member.

Before joining the Department in 2001 as assistant department head, Thuente was a professor of computer science and mathematical sciences at Purdue University-Fort Wayne (formerly IPFW) and was director of Graduate Programs there. He was largely responsible for the creation of the Purdue Graduate Program in Applied Computer Science there. He is a professor emeritus of Purdue University.

At NC State, as director of the Computer Science Graduate Programs, he led the expansion of the Ph.D. program in computer science from fewer than 50 students

in 2003 to nearly 200 Ph.D. students in 2010. For this work he was recognized in 2010 with The Joyce Hatch Service Award from ACM/AITP/NCSU and Outstanding Director of Graduate Programs by the CSC Graduate Student Association.

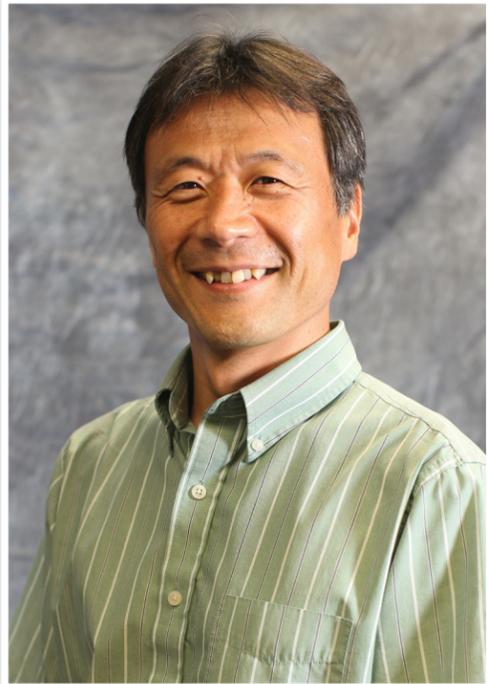
In his teaching career, Thuente taught more than 50 different courses including, at the graduate level, Computer Networking, Artificial Intelligence, Expert Systems, Heuristic Problem Solving, Introduction to Simulation and Modeling of Computer Systems, Performance Modeling and Evaluation of Computer Systems and Computational Methods in Analysis. He received Sigma Xi's College Science Teacher of the Year Award, the Outstanding Science Teacher Award from Indiana Science Education Fund and the Most Helpful Professor Outside of Class, ACM/AITP/NCSU, and other awards.

Thuente was a research fellow at Argonne National Laboratory in 1976, 1980 and 1983 in the Numerical Optimization group where he and Jorge More developed the Safeguarded Cubic Line Search algorithm that is still the standard and most widely used line search algorithm. It is part of nearly all general purpose nonlinear optimization packages.

He was a research scientist and consultant at Raytheon Systems Company from 1988 to 2003, where he did system design and wireless communication protocol development and testing for U.S. Army Command and Control Systems. He also spent a year at MITRE Corporation modeling satellite communication systems. He has more than 30 proprietary and classified papers from these positions. He has held more than 25 other consulting positions including Northrup Grumman, Hughes Aircraft Company, General Dynamics Land Systems, Lockheed Corporation, General Electric and OPNET Technologies, Inc.

Thuente has more than 90 refereed publications and more than \$2 million in research funding from Office of Naval Research and at Raytheon. He recently received an IBM Faculty Award.

He plans to continue to travel, golf, ski and use the NC State gym. He recently participated in two IBM Watson workshops, and the Geometry of Redistricting Workshop at Duke University sponsored by the Metric Geometry and Gerrymandering Group at Tufts University. Most of all, he is looking forward to seeing more of his grandchildren, and working with his son, who mentors a high school Science Olympiad team.



Dr. Noboru Matsuda

DR. NOBORU MATSUDA has joined the department as an associate professor in computer science. His research interests include innovating cutting-edge technologies to enhance learning as well as to advance cognitive theories in the sciences of learning with a particular focus on STEM education. He is particularly interested in innovating an artificial-intelligence technology for education that helps students learn, teachers teach, and researchers understand how people learn and fail to learn. His scholarly expertise spans education, learning science, cognitive science, and computer science. He received his B.S. and M.S. in mathematics education from Tokyo Gakugei University in Tokyo, Japan, and his Ph.D. in intelligent systems from the University of Pittsburgh (2004).



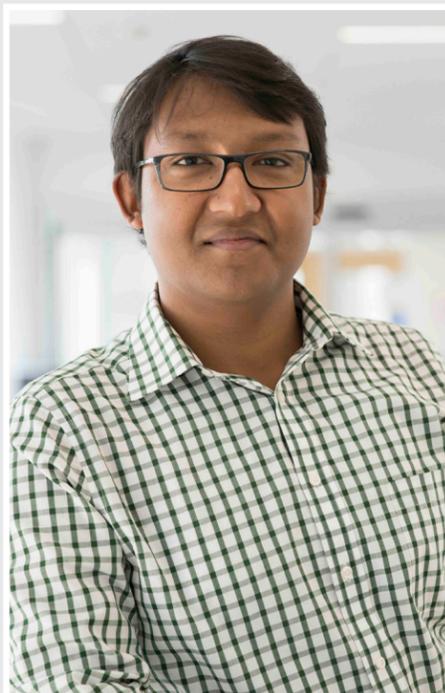
Dr. Thomas Price

DR. THOMAS PRICE has joined the department as an assistant professor in computer science. His research focuses on computing education, intelligent tutoring systems, educational data mining, and novice programming environments. He received his B.S. in computer science from Elon University (2013), and his M.S. (2015) and Ph.D. (2018) in computer science from NC State.



Dr. Bradley Reaves

DR. BRADLEY REAVES joined the department in January, 2018, as an assistant professor in computer science. His research is dedicated to measuring and improving the security and privacy of computer systems, with a particular emphasis on telephone networks and software for mobile platforms. This work has addressed detection and measurement of mobile malware in the wild, identified systemic risks in developing world mobile money systems, and provided new techniques to distinguish legitimate and fraudulent phone calls. He received his B.S. and M.S. in computer engineering from Mississippi State, his M.S. in computer science from Georgia Tech, and his Ph.D. from the University of Florida (2017).



Dr. Anupam Das

DR. ANUPAM DAS will join the department in January, 2019, as an assistant professor in computer science. Das' general area of specialty is security and privacy with a special focus toward designing secure and privacy-preserving technologies. His current research direction focuses on exploring the security and privacy challenges

in the era of Internet of Things (IoT), where he is focusing on designing frameworks that can discover, inform and control what information is shared with different data analytics. He received his B.S. and M.S. in computer science and engineering from Bangladesh University of Engineering and Technology in 2008 and 2010, respectively. He received his Ph.D. in computer science in 2016 from the University of Illinois at Urbana-Champaign, where he was a recipient of Fulbright Science and Technology fellowship. Prior to joining NC State, he was a postdoctoral fellow at Carnegie Mellon University.



Dr. Jamie Jennings

DR. JAMIE JENNINGS

has joined the department as a teaching assistant professor. Her research interests span a wide range, including theory, programming languages, software engineering, robotics, and artificial intelligence. Jennings was previously an assistant professor before her 19-year career as a technologist at IBM. During her IBM career, she developed widely adopted international technical standards for mobile telephony, and created the Rosie Pattern Language (rosie-lang.org). She received her B.S., M.S., and Ph.D. (1995) in computer science from Cornell University.



AMBASSADORS HELP SPARK AN INTEREST IN COMPUTER SCIENCE

While we live in a world surrounded by technology, only a small fraction of students pursue a degree or career in computer science. The Marbles Kid Museum in downtown Raleigh, NC, wants to change this by stimulating young minds early.

Led by ToniAnn Marini, assistant director of undergraduate advising in CSC, computer science student ambassadors Louis Le, Richard Marshall, Lauren Siegel, Michelle Lemons and Anastasia Egorova spent Saturday, Nov. 18th, 2017, helping spread the joy of computing at the Marbles < Kids > Code event in downtown Raleigh.

The event was intended to be a day to inspire kids to learn about coding, spark an interest in coding careers, and share ways to encourage coding and computer science exploration at home. By igniting an interest in coding and computer science in all kids from an early age, organizers hope to help demystify coding and spark an interest in technology-related careers.

More than 500 kids and family members were in attendance at the event.

STUDENTS WIN BIG ON BIG DATA

Three Ph.D. students in the department were recognized for their major accomplishments at the HPCC Systems Community Day in Atlanta, Georgia. Chin-Jung Hsu received a first-place poster award, George Mathew received a third-place poster award and Vivek Nair received a community innovation award.

Developed by LexisNexis, the HPCC Systems Summit Community Day brings together researchers and individuals from academia and the industry to exchange ideas and share

experiences on the advance in high-performance computing clusters. LexisNexis Risk Solutions has funded many research projects in computer science at NC State, helping students and facilities make impacts on research.

- The first-place poster, “HaaS: HPCC Systems-as-a-Service,” was written by Chin-Jung Hsu with the support of NC State and LexisNexis Risk Solutions. It is an open source data analytics supercomputer that is widely deployed to underpin its multi-billion-dollar business. Chin-Jung Hsu is advised by Dr. Vincent Freeh, associate professor in the department.

The project develops HaaS, a command line tool that helps streamline system deployment and management on the AWS cloud. HaaS enables users to deploy, save and restore an HPCC Systems cluster in minutes all while creating a cost-effective workflow of running data analytics applications in the cloud. The tool, which has greatly benefitted the HPCC community, can be downloaded from <https://github.com/vin0110/haas>.

- George Mathew’s third place poster, “Cohesive Framework for Legislative and Research Documents,” explores the correlation between research and legislation within the government. After dissecting 100,000 legislation and 75,000 research documents, a 97-percent similarity was found. Future plans for the poster include more research on a larger body of research documents and legislation. Mathew is advised by Dr. Timothy Menzies, professor in CSC.

- Vivek Nair, also advised by Menzies, received the community innovation award at the HPCC Systems Community Day. Nair’s award celebrates his paper, “Spark and HPCC: Strangers no More,” and his innovative use of HPCC Systems.

CATETÉ SHARES HER PASSION FOR COMPUTER SCIENCE

As a student at West Johnston High School in Benson, NC, Veronica Cateté wanted to take computer science. Advanced Placement computer science was finally offered as an online class during her senior year, but taking the class meant that she had to miss most of her final year of band class, where she was first chair oboist and pit captain.

So Cateté, who earned her Ph.D. in computer science on May 12, learned that if she worked ahead in her online class, eventually she would get to spend some time in band class. The reward inspired her to work quickly and efficiently through her programming assignments.

Her experience in high school convinced her that she wanted to study computer science at NC State. Early in her undergraduate career here, she would return home on the weekends to spend time with her preschool-aged sister, who was battling cancer. And to make that happen, she worked ahead to complete her classwork in order to get home on Fridays where, among other things, she taught her sister to use a computer.

Her sister died at age 5 when Cateté was a sophomore at NC State, and she needed to find another way to spend her time and talents. She got involved with SPARCS, a university outreach program that helps teach middle school students about computing, a fitting way to honor her sister’s memory. Cateté participated in the program for several years before expanding it and becoming regional coordinator. In these programs, the middle school students would come to campus for weekly classes or day camps on computing.

Throughout her computer science studies, Cateté has had one primary goal – to share her love of computing with others, especially middle school and high school students from underrepresented groups, including women and students from rural areas who face the same limitations in computing education that Cateté did.

When Cateté and her family moved to rural Benson, NC, from Ohio, she suddenly found herself in a strange, new world, “between tobacco fields and pig farms,” she said. Her excitement about her computer science class had a lasting impact on her life, and that’s something she wants others to experience.

Cateté says she didn’t come from a STEM family, though her mother worked in manufacturing and her stepfather had a doctorate in chemical engineering. When she came to study computer science at NC State, she really didn’t know how that



discipline differed from other fields of computer studies.

“When deciding to major in computer science, I did not know the difference between computer engineering, computer science, software engineering or a programming certificate, so I just signed up for the major that was the name of my class,” she said.

Cateté has shared her passion for computing through many different outreach efforts that involve teaching computing to middle or high school students, either at their own schools or at her university campus. In 2017, she received an Equity Award for Women from NC State’s Council on the Status of Women, recognizing her service.

She carried the SPARCS program with her to the University of North Carolina-Charlotte, where she earned a master’s degree in computer science. The SPARCS program continues at UNCC today. From 2013-16, Cateté was president of NC State’s STARS group that oversees SPARCS outreach, until an advisor told her she needed to give up the role and work on completing her doctorate.

Through STARS, she helped launch the Lady Wolf App-A-Thon, a recruiting effort in which high school girls come to NC State to try their hand at computing applications. She was also involved in FLAMES – Females Learning Awesome Math, Engineering and Sciences – a high school computer outreach program.

One of her most meaningful training efforts was a six-week program in Rwanda called Pivot Academy, where she partnered with the non-profit Mothering Across Continents and recruited four other people from NC State to join the effort. The main group that traveled to Rwanda stayed for two weeks, while Cateté and another graduate student stayed on for four more weeks as researchers.

A big part of the effort involved helping high school students to develop mobile apps for social good. Corporate donors sent

the group with tablets – 40 for a classroom, Cateté said. The students determined the type of apps they wanted to develop.

“One was a milk delivery app, where you could enter in the type of milk you wanted, how much you needed and your location,” Cateté said. “It would send a ping off to a delivery service, and they would deliver milk to your home. I would never have thought of that, but that’s really cool.”

The Pivot Academy for the girls in Rwanda — which focused on physics, chemistry, biology and computing — took place the first two weeks of the program. Student groups worked on projects as part of the academy. One group of girls wanted to build an orphanage, so Cateté and crew helped the girls turn the project into a budgeted project proposal.

Cateté said the group also found other uses for the tablets.

“Teachers wanted science books put on the tablets because there wasn’t a set of classroom books. Before they got the tablets, they would handwrite texts onto blackboard, then students copied them onto paper. But we needed to provide them with materials that didn’t require an Internet connection, because connectivity was not always reliable,” she said.

The group showed teachers how to network the class tablets so that when they added new information to the texts, it would appear on all tablets. Cateté and her colleagues also demonstrated the tablets’ camera features and how the camera could be used in science, even to “video chat” with a scientist who lived across the globe.

Cateté’s research has focused on “broadening participation in computing” and is based on a National Science Foundation initiative to get more people in computing, especially under-represented minorities, women and people from rural areas, like herself. In the process, she realized that many high school teachers responsible for new Advanced Placement computer science principles classes have little or no real computer experience.

AP Computer Science Principles just rolled out this academic year, and as a result, there is a need for more computer science teachers, she said. “Usually (high school programming teachers) only have one to two years of programming experience. So my goal was to find out how you teach someone to teach AP Computer Science Principles when they don’t actually having a computer science background,” Cateté said.

After graduating in May, Cateté is continuing her work at NC State. She will continue her work here as a research scientist with the STEM + C project (c for computing), a joint initiative between the Computer Science department, the Citadel, and

NC State’s Friday Institute for Educational Innovation. The STEM + C project works to help integrate computing into K-12 STEM courses by training teachers on how to use computational thinking activities in their classrooms.

SHASHIDHARAN NAMED INTERNATIONAL STUDENT OF THE YEAR

Ashwin Shashidharan, a Center for Geospatial Analytics doctoral



student in CSC, was selected as the 2018 Esri Development Center International Student of the Year.

The Esri Development Center (EDC) program confers special status and benefits upon a select few leading university departments that challenge their students to develop innovative applications based upon the ArcGIS platform and related elements of the geospatial technology ecosystem. One benefit of the program is a cash prize, certificate, and Esri Press book awarded to a Student of the Year named by each EDC.

Shashidharan, who gained international accolades for his cutting-edge research in computational steering for geosimulations, was also named NC State University’s Esri Development Center Student of the Year, the university’s first awardee.

The Esri Development Center (EDC) Program for Higher Education was established by the world’s top GIS software company, Esri, to “confer special status and benefits upon a select few leading university departments that challenge their students to develop innovative applications based upon the ArcGIS platform.” The Center for Geospatial Analytics was invited by Esri to become an EDC in Fall 2017. Each EDC worldwide can honor one student each year who has shown exemplary work in the area of GIS development and application.

Shashidharan is jointly advised by Dr. Raju Vatsavai, the Center for Geospatial Analytics’ associate director of computing and technology, and center director Dr. Ross Meentemeyer.

JOIN the Department of Computer Science on campus THIS FALL



Questions?

Contact Ken Tate at 919.513.4292 or kmtate2@ncsu.edu.

1 **SEPTEMBER 17**
ePartner Career Connection recruiting event for the Department’s ePartner companies
TALLEY STUDENT UNION
NOON - 4 P.M.

2 **SEPTEMBER 27**
Fidelity Investments Leadership in Technology Speakers Series
Erik Troan, CTO and founder of Pendo
1231 ENGINEERING BUILDING II
6:30 P.M.

3 **OCTOBER 23**
Fidelity Investments Leadership in Technology Speakers Series
Larry Weber, head of product marketing, AWS relational databases, with Amazon
1231 ENGINEERING BUILDING II
6:30 P.M.

4 **FRIDAY, NOV. 2**
Computer Science Alumni Hall of Fame Induction Breakfast
PARK ALUMNI CENTER
8:30 A.M.
Invitation only

5 **FRIDAY, NOV. 2**
New Department Head Vision Presentation
1231 ENGINEERING BUILDING II
10 A.M.
RSVP requested

6 **NOVEMBER 15**
Fidelity Investments Leadership in Technology Speakers Series
Jamie Thomas, general manager, systems strategy and development, at IBM
1231 ENGINEERING BUILDING II
6:30 P.M.

7 **DECEMBER 7**
CSC Senior Design Center Fall Posters and Pies Event
JAMES B. HUNT JR. LIBRARY
10:40 A.M.
RSVP requested

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