

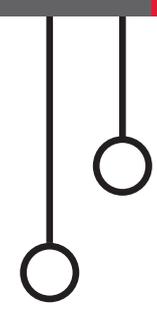
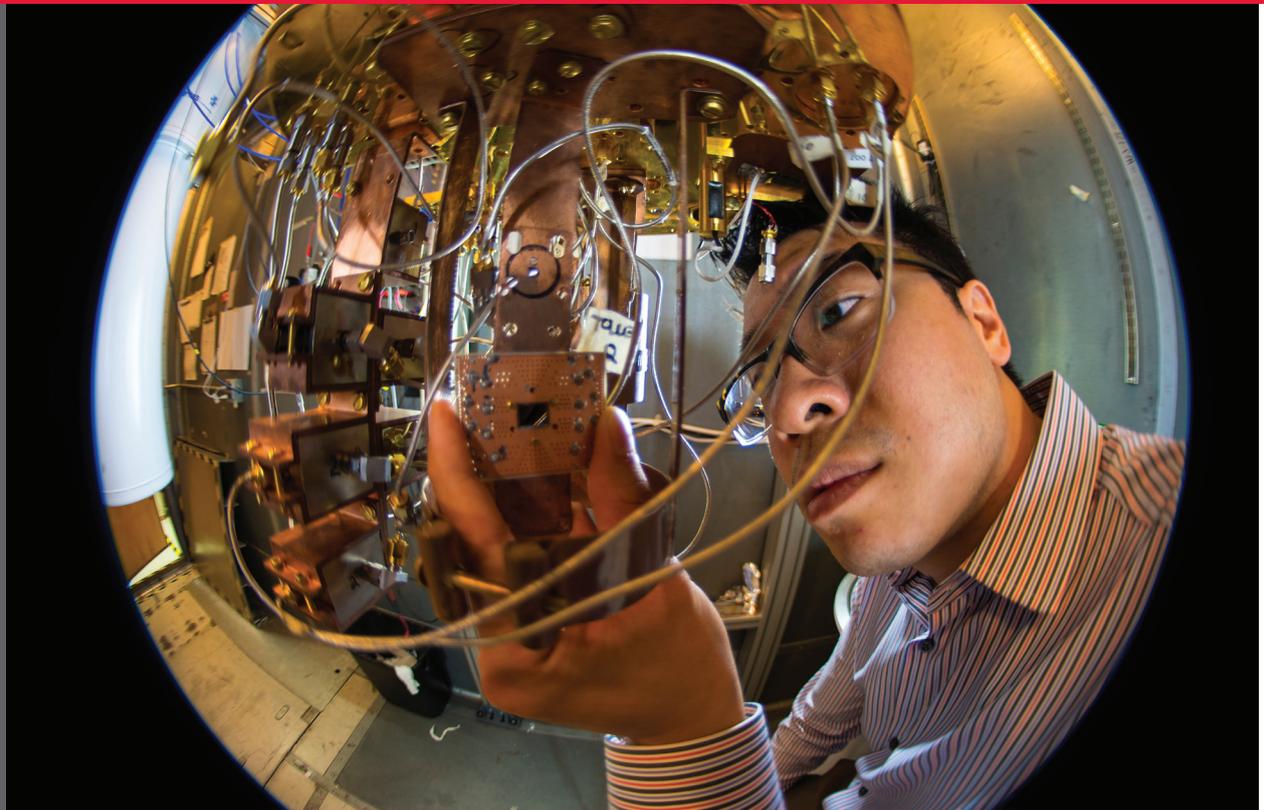
RESEARCH

2017 – 2018

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.



INSIDE:

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- Faculty Profiles

Welcome to the latest edition of the NC State Computer Science (CSC) Department's Research newsletter! It is my pleasure to share this issue of our newsletter, our annual synopsis of research activities in the Department. But before I share these highlights, I am thrilled to announce that after an exhaustive year-long international search, we are extremely excited to welcome **Dr. Gregg Rothermel** as the CSC department's new department head on November 1st.



An IEEE Fellow and ACM Distinguished Scientist, Gregg comes to us from the University of Nebraska-Lincoln where he was a 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. 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 received his PhD in computer science from Clemson University, his MS in computer science from SUNY Albany, and a BA 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.

We are excited to welcome Gregg, and we are also excited to share some of the most recent successes of the Department, our faculty, staff and students have experienced over the past year. Here are a few highlights that deserve special notice:

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Research Highlights

- 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.
- 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 University 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 **James Lester**, a distinguished professor of computer science at NC State and principal investigator on the DeepGen project.
- Over the last 10 years, NC State **ranks No. 2** in the world in publishing at conferences and journals dedicated to games and interactive entertainment computing research. Mark J. Nelson, a Senior Research Fellow at the MetaMakers Institute of Falmouth University in Falmouth, England, collected the data on universities and institutions and compiled the rankings.
- **Dr. Laurie Williams**, interim head of the department and co-director of the Science of Security Lablet at NC State, has received two recent significant honors. Williams has been named a Distinguished Professor of Computer Science. She has also been elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). 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 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.
- Computer science researchers have developed an artificial intelligence (AI) game-playing program that exhibits social reasoning and "intentionality" – meaning it can infer how other players are likely to respond to new information and what other players likely want from the AI when they share information. The program serves as a proof of concept for a new programming framework the researchers have developed for creating more intentional AI programs. "People are already interacting with AI programs, whether they know it or not, and that's likely to increase over time," says **Chris Martens**, assistant professor of computer science and senior author of two papers on the work. "We think it's important for AI programs to be able to communicate effectively with users. Being able to gauge people's intentions is a critical part of how people communicate with each other, and we think our work here is a step toward incorporating that kind of intentionality into AI in a meaningful way."
- **Dr. Min Chi**, assistant professor of computer science, was recently awarded the Alcoa Foundation Research 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.



(continued from page 1)

- 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. **Dr. Laurie Williams** is the principal investigator of the NC State Lablet.
- NC State will be partnering with the University of Maryland Baltimore County (lead institution), Rutgers University New Brunswick, Rutgers University Newark and a diverse group of industry partners on the new **Center for Accelerated Real Time Analytics (CARTA)**. CARTA will visualize and address the future advanced, real-time analytics needs of industry and society. **Dr. Rada Chirkova** will be the director of the NC State site (CARTA/NC SU), and **Dr. David Wright** will serve as the associate director.
- **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.

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. This ranks us in the top ten departments for sponsored research funding among computer science departments in colleges of engineering in the United States. On page two you will see a list of some of our research highlights, and a list of representative projects appears on page four of this newsletter. We invite you to visit our website at csc.ncsu.edu to learn more about the department, our faculty and staff and our state-of-the-art research.

Providing the best possible education to our students is also key to our mission. Our graduates continue to be in high demand with annual salaries for undergrads averaging \$72,000, and those graduating with an MS averaging more than \$110,000. For PhD graduates, it's even higher. NC State's online graduate program in computer science moved up two spots to No. 4 on the U.S. News & World Report's latest ranking of online degree programs, making it one of the highest ranked online programs at NC State. And, we continue to be the top supplier of talent to IBM, Cisco, Amazon, NetApp, SAS, Red Hat and other top financial and IT organizations, as well as other technology-driven companies.

Our faculty and staff have received numerous prestigious awards and professional recognitions: **Dr. George Rouskas**, director of graduate programs and professor, has been recognized as an Alumni Association Distinguished Graduate Professor for 2018; **Dr. Sarah Heckman**, director of undergraduate programs and teaching associate professor, has been selected as a recipient of an Alumni Distinguished Undergraduate Professor Award for 2017-18; **Dr. Xipeng Shen**, professor, has been named a 2017-2018 University Faculty Scholar. The Scholars program recognizes and rewards academic leaders at NC State; and **Dr. Jason King**, teaching assistant professor, was presented with the Gertrude Cox Award for Innovative Excellence in Teaching and Learning with Technology. This award honors the creative pedagogy of NC State's faculty and technical staff and their work in integrating new technologies into effective teaching strategies.

As my final months as interim department head come to an end, I would like to express my heartfelt appreciation to the faculty and staff who have served with me over the past 18+ months. It is an honor to work alongside some of the most accomplished professionals at NC State University as we eagerly anticipate the arrival of our new department head on November 1st!

Dr. Laurie Williams
Interim Department Head and Professor

Selected Research Projects

Consortium for Nonproliferation Enabling Capabilities, **Nagiza Samatova, Robin Gardner. \$9,744,249 by US Department of Energy.**

ENGAGE: A Game-based Curricular Strategy for Infusing Computational Thinking into Middle School Science, **James Lester, Bradford Mott, Eric Wiebe. \$2,498,862 by National Science Foundation.**

DIP: Integrated Data-driven Technologies for Individualized Instruction in STEM Learning Environments, **Min Chi, Tiffany Barnes. \$1,999,438 by National Science Foundation.**

Multimodal Visitor Analytics: Investigating Naturalistic Engagement with Interactive Tabletop Science Exhibits, **James Lester, Jonathan Rowe, James Minogue. \$1,951,956 by National Science Foundation.**

Moore Foundation Data-Driven Discovery Investigator, **Blair Sullivan. \$1,500,000 by Gordon and Betty Moore Foundation.**

Collaborative Research: PRIME: Engaging STEM Undergraduate Students in Computer Science with Intelligent Tutoring Systems, **James Lester, Bradford Mott, Eric Wiebe. \$1,499,828 by National Science Foundation.**

Collaborative Research: Fostering Collaborative Computer Science Learning with Intelligent Virtual Companions for Upper Elementary Students, **Collin Lynch, Eric Wiebe. \$1,399,088 by National Science Foundation.**



DeepGen: Dynamic Generation of Training Simulation Scenarios with Deep Reinforcement Learning, **James Lester, Bradford Mott, Jonathan Rowe. \$1,398,004 by US Army – Army Research Laboratory.**

Health Quest: Engaging Adolescents in Health Careers with Technology-Rich Personalized Learning, **James Lester. \$1,301,820 by National Institute of Health (NIH).**

Investigating Emergency Response Performance with VR-Based Intelligent User Interfaces, **James Lester, Bradford Mott, Randall Spain. \$1,112,175 by National Institute of Standards and Technology.**

Using Real-Time Multichannel Self-Regulated Learning Data to Enhance Student Learning and Teachers' Decision-Making with MetaDash, **Min Chi, Roger Azevedo (Psychology), Soonhye Pakr (Education). \$914,585 by National Science Foundation.**

Scalable Holistic Autotuning for Software Analytics, **Timothy Menzies, Xipeng Shen. \$898,349 by National Science Foundation.**

Identification of Translational Hormone-Response Gene Networks and Cis-Regulatory Elements, **Steffen Heber, Jose Alonso, Anna Stepanova, Cranos Williams. \$897,637 by National Science Foundation.**

Collaborative Research: Integrating Computing in STEM: Designing, Developing and Investigating a Team-based Professional Development Model for Middle and High

School Teachers, **Tiffany Barnes. \$861,773 by National Science Foundation.**

IUCRC Pre-Proposal Phase I NC State University: Center for Accelerated Real Time Analytics (CARTA), **Rada Chirkova. \$747,647 by National Science Foundation.**

CAREER: Improving Adaptive Decision Making in Interactive Learning Environments, **Min Chi. \$547,810 by National Science Foundation.**

Algorithms for Exploiting Approximate Network Structure Research Area 10: Network Science, **Blair Sullivan. \$538,199 by US Army-Army Research Office.**

CAREER: On the Foundations of Semantic Code Search, **Kathryn Stolee. \$500,000 by National Science Foundation.**

Supporting Position Independence and Reusability of Data on Byte-Addressable Non-Volatile Memory, **Xipeng Shen. \$499,998 by National Science Foundation.**

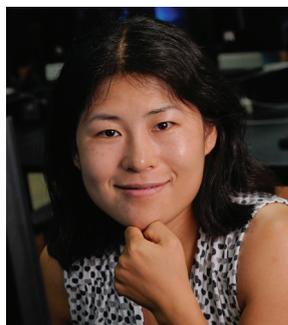
Supporting Regular Expression Testing, Search, Repair, Comprehension, and Maintenance, **Kathryn Stolee. \$499,996 by National Science Foundation.**

Science of Security Lablet: Impact Through Research, Scientific Methods, and Community Development, **Laurie Williams, Munindar Singh. \$467,750 by US Department of Defense (DOD).**

Fine-grained Measurement of Performance Metrics in the Internet of Things, **Muhammad Shahzad. \$449,999 by National Science Foundation.**

Taming Web Content Through Automated Reduction in Browser Functionality, **Alexandros Kapravelos. \$406,609 by National Science Foundation.**

Transforming Computer Science Education Research Through Use of Appropriate Empirical Research Methods: Mentoring and Tutorials, **Sarah Heckman. \$406,557 by National Science Foundation.**



FEED: Flexible, Equitable, Efficient and Effective Distribution, **Min Chi, Julie Ivy. \$400,000 by UNC-NC A&T University.**

Collaborative Research: Semi and Fully Automated Program Repair and Synthesis via Semantic Code Search, **Kathryn Stolee. \$387,661 by National Science Foundation.**

Realizing Cyber Inception: Toward a Science of Personalized Deception for Cyber Defense, **Munindar Singh. \$375,360 by University of Southern California via US Army Research Office.**

DockerizeME: Automatic Inference and Repair of Computing Environments, **Christopher Pamin. \$345,875 by National Science Foundation.**



New Faculty Profiles



NOBURU MATSUDA

joined the department in fall 2018 as an associate professor. 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 received his BS and MS in mathematics education from Tokyo Gakugei University, and his PhD (2004) in intelligent systems from the University of Pittsburgh.



ANUPAM DAS

will join the department in spring 2019 as an assistant professor. His area of specialty is security and privacy with a special focus on designing secure and privacy-preserving technologies. He received his BS and MS in computer science and engineering from

Bangladesh University of Engineering and Technology, and his PhD (2016) in computer science from the University of Illinois at Urbana-Champaign where he was a recipient of a Fulbright Science and Technology Fellowship.



THOMAS PRICE

joined the department in fall 2018 as an assistant professor. His research focuses on computing education, intelligent tutoring systems, educational data mining, and novice programming environments. He received his BS in computer science from Elon University,

and his MS and PhD (2018) in computer science from NC State.



JAMIE JENNINGS

joined the department in fall 2018 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. She received her BS, MS and PhD (1995) in computer science from Cornell University.

Senior Faculty Spotlight



DR. RADA CHIRKOVA

Professor of Computer Science

Chirkova received her BS and MS in applied mathematics from Moscow State University, and her MS and PhD (2002) in computer science from Stanford University.

She is the director of the NC State Computer Science Laboratory for the Science of Technologies for End-to-End

Enhancement of Data (STEED); director of the NC State site

of the NSF I/UCRC Center for Accelerated Real Time Analytics (CARTA) (2018-2023); and director of the NC State site of the NSF I/UCRC Center for Hybrid Multicore Productivity Research (CHMPR) (2016-2018).

Her research interests include algorithms and theory of computation, cyber security, data sciences and analytics, health care information technology and information and knowledge management.

She has received many accolades including being named a senior member of the Association for Computing Machinery (ACM); IBM Faculty Awards in 2007, 2010, 2011, 2012, and 2014; IBM University Partnership Program Awards in 2003, 2004 and 2007; National Science Foundation Faculty Early CAREER Award in 2005; and Faculty Research and Professional Development Award in 2003.

Researchers*

Dennis R. Bahler, Associate Professor
PhD, University of Virginia, 1987

Artificial intelligence: constraint processing, machine learning, hybrid neural-symbolic computing

Tiffany Barnes, Professor
PhD, NC State University, 2003

Educational data mining, serious games for education, health and energy, broadening computing participation

Donald Bitzer, Distinguished University Research Professor
PhD, University of Illinois, 1960

Convolutional codes, signal processing for biological systems, computer-based education

Franz Brglez, Visiting Research Professor
PhD, University of Colorado, 1970

Distributed and collaborative workflows, databases, and groupware for the Internet

Min Chi, Assistant Professor
PhD, University of Pittsburgh, 2009

Machine learning, artificial intelligence, cognitive science and learning science

Rada Y. Chirkova, Professor
PhD, Stanford University, 2002

Database performance, query-processing efficiency, data sciences

Jon Doyle, SAS Professor of Computer Science
PhD, Massachusetts Institute of Technology, 1980

Artificial Intelligence, mathematical and philosophical foundations, rational agents, decision making

Patrick Dreher, Research Professor
PhD, University of Illinois, 1991

Cloud computing, scientific and high performance computing

Rudra Dutta, Professor
PhD, NC State University, 2001

Network design: optical, wireless sensor and mesh networks; future Internet design

William Enck, Associate Professor
PhD, The Pennsylvania State University, 2011

Systems security, mobile operating systems security

Vincent Freeh, Associate Professor
PhD, University of Arizona, 1996

Operating systems, compilers, programming languages, storage

Edward Gehringer, Professor
PhD, Purdue University, 1979

Memory management, object-oriented software systems, computer-aided education

Xiaohui (Helen) Gu, Associate Professor
PhD, University of Illinois, 2004

Distributed systems, operating systems, computer networks

Khaled Harfoush, Associate Professor
PhD, Boston University, 2002

Computer networking, Internet measurements, peer-to-peer systems, routing protocols

Christopher G. Healey, Goodnight Distinguished Professor
PhD, University of British Columbia, Canada, 1996

Visualization and computer graphics: methods for rapidly, accurately, effectively visualizing large complex datasets

Steffen Heber, Associate Professor
PhD, Universität Heidelberg, Germany, 2001

Algorithms to compare and analyze gene order permutations, animation development for bioinformatics education

Arnav Jhala, Associate Professor
PhD, NC State University, 2009

Artificial intelligence, storytelling in games, intelligent machinima generation, smart graphics, and intelligent user interfaces

Guoliang Jin, Assistant Professor
PhD, University of Wisconsin-Madison, 2014

Architecture and operating systems, parallel and distributed systems, software engineering and programming languages

Alexandros Kapravelos, Assistant Professor
PhD, University of California-Santa Barbara, 2015

Systems and software security

Michael Kowolenko, Managing Director of ITng
PhD, Northeastern University, 1985

Data science

James C. Lester, Distinguished Computer Science Professor
PhD, University of Texas, 1994

Artificial intelligence, intelligent user interfaces, intelligent tutoring systems, computational linguistics

Collin Lynch, Assistant Professor
PhD, University of Pittsburgh, 2014

Graph-based educational data mining, development of robust intelligent tutoring systems, adaptive educational systems for ill-defined domains

Chris Martens, Assistant Professor
PhD, Carnegie Mellon University, 2015

Formal methods for creative media, game design, believable virtual agents, collaborative digital storytelling, simulation modeling

Noboru Matsuda, Associate Professor
PhD, University of Pittsburgh, 2005

Technology innovation and integration to advance the sciences of learning

Tim Menzies, Professor
PhD, University of New South Wales, 1995

Artificial intelligence, data-mining and search-based software engineering

Bradford Mott, Senior Research Scientist
PhD, NC State University, 2006

Artificial intelligence, game-based learning environments, computational models of interactive narrative

Frank Mueller, Professor
PhD, Florida State University, 1994

Compilers and code optimization, concurrent and distributed, real-time and embedded systems

Emerson Murphy-Hill, Associate Professor
PhD, Portland State University, 2009

Software engineering, especially the intersection of human-computer interaction and software engineering.

Kemafor Anyanwu Ogan, Associate Professor
PhD, University of Georgia, 2007

Semantic computing: semantic Web, databases, data mining, information retrieval, services computing

Chris Parnin, Assistant Professor
PhD, Georgia Institute of Technology, 2014

Graphics and computer interaction, software engineering, programming languages

Harry Perros, Alumni Distinguished Graduate Professor
PhD, Trinity College, Ireland, 1975

Performance analysis of optical networks, performance monitoring of grids, queueing networks



*list includes 2017-18 faculty as well as faculty promotions, and faculty joining the department in August 2018.

Thomas Price, Assistant Professor
PhD, NC State University, 2018

Computing education, intelligent tutoring systems, educational data mining, and novice programming environments

Michael Rappa, Distinguished University Professor
PhD, University of Minnesota, 1987

Analytics, e-commerce, open courseware, open educational content, technology management

Bradley Reaves, Assistant Professor
PhD, University of Florida, 2017

Measuring and improving the security and privacy of computer systems, with emphasis on telephony networks and software for mobile platforms

Douglas S. Reeves, Professor
PhD, The Pennsylvania State University, 1987

Architecture and operating systems, cyber security, networking and performance evaluation

David Roberts, Associate Professor
PhD, Georgia Institute of Technology, 2010

Machine learning and artificial intelligence and their application to interactive technological experiences

George N. Rouskas, Alumni Distinguished Graduate Professor
PhD, Georgia Institute of Technology, 1994

Network architectures and protocols, optical networks, grid computing

Nagiza Samatova, Professor (joint apt. w/ORNL)
PhD, Russian Academy of Science (CCAS), 1993

Graph theory and algorithms, bioinformatics, systems biology, data management, data integration, data science

Carla D. Savage, Professor
PhD, University of Illinois, 1977

Combinatorics, combinatorial algorithms, network algorithms, graph theory, discrete mathematics

Alessandra Scafuro, Assistant Professor
PhD, University of Salerno, 2013

Cryptography, secure computation

Muhammad Shahzad, Assistant Professor
PhD, Michigan State University, 2015

Embedded and real-time systems, networking and performance evaluation, cyber security

Xipeng Shen, Professor
PhD, University of Rochester, 2006

Architecture and operating systems, extreme-scale data-intensive computing

Munindar Singh, Professor
PhD, University of Texas, 1993

Multiagent systems, intelligent agents, service-oriented computing, agent languages and protocols

Robert St. Amant, Professor
PhD, University of Massachusetts, Amherst, 1996

Human-computer interaction, artificial intelligence, intelligent user interfaces, statistical expert systems

Matthias Stallmann, Professor
PhD, University of Colorado, 1982

Algorithm design and analysis of serial and parallel models of computation

William J. Stewart, Professor
PhD, Queen's University, Northern Ireland, 1974

Performance evaluation of computer sys., numerical linear algebra, computer operating systems

Kathryn Stolee, Assistant Professor
PhD, University of Nebraska-Lincoln, 2013

Program analysis, empirical software engineering and crowdsourcing

Blair Sullivan, Associate Professor (joint apt. w/ORNL)
PhD, Princeton University, 2008

Algorithms and theory of computation, scientific and high performance computing, and analytics

David Thuente, Professor
PhD, University of Kansas, 1974

Denial of service and security for wireless systems; media access control protocols

Hung-Wei Tseng, Assistant Professor
PhD, University of California-San Diego, 2014

Systems, heterogeneous computing

Ranga Raju Vatsavai, Associate Professor (joint apt. w/ORNL)
PhD, University of Minnesota, 2008

Advanced data sciences, geospatial analytics

Mladen Vouk, Distinguished Computer Science Professor
PhD, King's College, England, U.K., 1976

Software engineering, scientific computing, computer-based education, cloud computing, data science

Benjamin Watson, Associate Professor
PhD, Georgia Institute of Technology, 1997

Relationships between computer graphics and design

Laurie Williams, Distinguished Computer Science Professor
PhD, University of Utah, 2000

Agile software processes, software security, open software systems, healthcare information technology

Teaching Professors

Suzanne Balik, Teaching Assistant Professor
PhD, NC State University, 2014

Graphics, human computer interaction

Lina Battestilli, Teaching Assistant Professor
PhD, NC State University, 2005

Computer science education, cloud computing and datacenter networks, networking architecture

Sarah Heckman, Teaching Associate Professor
PhD, NC State University, 2009

Computer science and software engineering education, open educational resources

Jamie Jennings, Teaching Assistant Professor
PhD, Cornell University, 1995

Theory, programming languages, software engineering, robotics, and artificial intelligence

Jason King, Teaching Assistant Professor
PhD, NC State University, 2016

Logging for user accountability, nonrepudiation and forensicability

Jessica Young Schmidt, Teaching Assistant Professor
PhD, NC State University, 2012

Scholarship of teaching and learning

David Sturgill, Teaching Associate Professor
PhD, Cornell University, 1996

Parallel computation and its application to computationally hard problems, parallelism, machine learning intelligence



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Computer Science Research

Our key research areas are in:

- **Artificial Intelligence and Theory** (including Intelligent Agents, Machine Learning, Knowledge Representation, Planning, Natural Language Processing, Computational Economics and Management, Algorithms, Theory of Computation)
- **Computational Applications and Analytics** (including Data Intensive Computing, Scientific Computing, Bioinformatics, Data/Text Mining, Information Visualization, HealthCare Information Technology, Analytics Clouds, Data Science)
- **Games, Interaction, and Education Informatics** (including Games, Human-Computer Interaction, Graphics, Intelligent Tutoring, Undergraduate Education in Computing)
- **Security and Networks** (including Software and Network Systems Security, Information Assurance, Privacy, Policies, Regularity Compliance, Networking and Performance Evaluation, Web security, Mobile security, Crypto, Internet of Things)
- **Software Engineering and Systems** (including Requirements, Formal Methods, Policies, Reliability Engineering, Process and Methods, Programming Languages, Computer Architectures and Operating Systems, Databases, Embedded and Real-Time Systems, Parallel and Distributed Systems, High Performance Computing, Cloud Computing)

The department has a number of teaching and research laboratories, centers, institutes and other facilities that support its education, research and outreach missions.

NC STATE Engineering

Department of Computer Science
Campus Box 8206
Raleigh, NC 27695-8206

Editor: Ken Tate; Associate Editor: Tammy Coates

1,600 copies of this document were printed at a cost of \$1,561.

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