

# IMPACT IMPACT IMPACT IMPACT

## NSA Science of Security “Lablet” Established at NC State

North Carolina State University, the University of Illinois at Urbana-Champaign and Carnegie Mellon University are each receiving an initial \$2.5 million in grant funds from the U.S. National Security Agency (NSA) to stimulate research into a scientific basis for the design and analysis of trusted systems.

The co-principal investigators for the NC State Science of Security Lablet are **Dr. Laurie Williams**, professor of computer science, and **Dr. Michael Rappa**, director of the Institute of Advanced Analytics and professor of computer science.

It is widely understood that critical cyber systems must inspire trust and confidence, protect the privacy and integrity of data resources, and perform reliably. To tackle the ongoing challenges of securing tomorrow’s systems, the NSA concluded that a collaborative community of researchers from government, industry and academia is a must.

*The NC State lablet will contribute broadly to the development of Security Science while leveraging NC State’s expertise and experience in analytics.*

To that end, the NSA grant has seeded academic “lablets” focused on the development of a Science of Security (SoS) and a broad, self-sustaining community effort to advance it. A major goal is the creation of a unified body of knowledge and analytics methods and tools that can serve as the basis of a trust engineering discipline, curriculum, and rigorous design methodologies. The results of SoS lablet research are to be extensively documented and widely distributed through the use of a new, network-based collaboration environment. The intention is for that environment to be the primary resource

for learning about ongoing work in security science, and to be a place to participate with others in advancing the state of the art.

The NC State lablet, which is housed in the Institute for **Next Generation IT Systems (ITng)**, will contribute broadly to the development of Security Science while leveraging NC State’s expertise and experience in analytics, including the extensive expertise available in the **NC State Institute of Advanced Analytics**.

The lablet’s work draws on several fundamental areas of computing research and on the related analytics. Some ideas from fault-tolerant computing can be adapted to the context of security. Strategies from control theory will be extended to account for the high variation and uncertainty that may be present in systems when they are under attack. Game theory and decision theory principles will be used to explore the interplay between attack and defense. Formal methods will be applied to develop formal notions of security resiliency. End-to-end system analysis will be employed to investigate resiliency of large systems against cyber attack. The lablet’s work will draw upon ideas from other areas of mathematics, statistics and engineering as well.

Established in 2007, the Institute for Advanced Analytics provides graduate education and promotes research in the emerging field of analytics. The institute’s flagship educational program is the nation’s first and pre-eminent Master of Science in Analytics (MSA) degree. The MSA is an intensive, full-time, 10-month learning experience.

The ITng is a research organization located within NC State’s College of Engineering. Its mission is to provide a forum for collaboration between government, industrial and university partners, faculty and students to research and implement solutions that address current IT challenges.



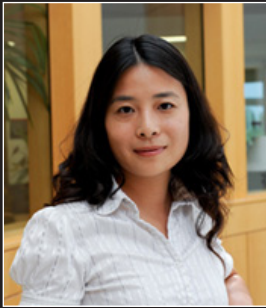
### Inside this Issue

- NC State Developing Video Game to Boost Computer Science Literacy **2**
- Protecting Sensitive Data in the Cloud **2**
- NC State to Collaborate on “Big Data” Initiative **3**
- Data Defender - Unmasking Malware **3**
- White House Honors Sina Bahram as a “Champion of Change” **4**
- Marshall Brain Honored as College of Engineering Distinguished Alumnus **4**
- Designing the Future of the Internet **4**

Fall 2012 Issue

## Impact Bytes

**Dr. George Rouskas** has been honored as an **IEEE Fellow** for his contributions to optical network design research. He is now the sixth IEEE Fellow in the department joining **Drs. Donald Bitzer** (1982), **Wushow "Bill" Chou** (1987), **Mladen Vouk** (2001), **Munindar Singh** (2008), and **Harry Perros** (2009).



**Dr. Xiaohui (Helen) Gu** (pictured above) has received a **Faculty Early Career Development (CAREER) Award** from the **National Science Foundation (NSF)**. The award, valued at \$450,000, supports her proposal titled, "Enable Robust Virtualized Hosting Infrastructures via Coordinated Learning, Recovery and Diagnosis." Gu becomes the **21st NSF CAREER winner for the Computer Science Department at NC State (the 19th currently on faculty)**, one of the highest concentrations of any department in the nation.

**Dr. Frank Mueller**, professor of computer science, was named a member of the **IEEE Computer Society's Golden Core**.

**Drs. Frank Mueller** and **Laurie Williams**, professors of computer science, were named **2011 Distinguished Scientists** by the **Association of Computing Machinery (ACM)**.

For the second year in a row, the **NC State Video Game Design Program** was recognized as one of the top undergraduate programs to study video game design on **The Princeton Review's "Top Schools for Video Game Design Study for 2012."**

Want a quick estimate of what **Twitter** users are tweeting - and feeling - right now, on virtually any topic? NC State has an online tool for that. **Dr. Christopher Healey** and his students can capture online sentiment through **Twitter Viz**, a Web tool that graphically displays the emotions expressed in tweets and maps them based on pleasantness or unpleasantness of the emotion, and the emotion's intensity. Virtually any topic - from cat videos to campaign promises - can be assessed. This can be particularly important in an election year! ■

## NC State Developing Video Game to Boost Computer Science Literacy

NC State researchers are launching a project to develop a video game that will help improve computer science knowledge in middle school students - and contribute to a better-educated workforce in the future. The game is being developed under a \$1 million grant from the National Science Foundation (NSF), and could be used nationally if successful.

"Looking ahead, the United States is facing a significant shortage of people who will be able to fill jobs in science, technology, engineering and mathematics fields. That shortage is particularly acute for computer science," says **Dr. James Lester**, a professor of computer science and primary investigator (PI) of the project. "Forecasts consistently predict that we will have far more computer science jobs than there will be trained personnel to fill them."

One reason for this problem is a lack of students entering college with a basic knowledge of computer science. The shortage is particularly marked among girls, who tend to steer away from math and computer science in middle school, studies show.

While the project is not specifically focused on boys or girls, the researchers plan to incorporate game elements designed to engage female students. For example, elements of the game will be linked to real-world issues such as public health and environmental challenges, which have been shown to appeal to female students.

The researchers will also be working with middle-school teachers and administrators in North Carolina to develop and test the game - and to assess the effectiveness of the program in the classroom.

"We need to make sure this produces real results," Lester says. "And if it does, we would like to roll the program out nationally."

Co-PIs on the project include **Dr. Kristy Boyer**, assistant professor of computer science; research scientist **Dr. Bradford Mott**; and **Dr. Eric Wiebe**, an associate professor of science, technology, engineering and mathematics education at NC State. ■

## Protecting Sensitive Data in the Cloud



Researchers from NC State, lead by **Dr. Peng Ning**, and IBM have developed a new, experimental technique to better protect sensitive information in cloud computing - without significantly affecting the system's overall performance.

Under the cloud-computing paradigm, the computational power and storage of multiple computers is pooled, and can be shared by multiple users. Hypervisors are programs that create the virtual workspace that allows different operating systems to run in isolation from one another - even though each of these systems is using computing power and storage capability on the same computer. A concern in cloud computing is that attackers could take advantage of vulnerabilities in a hypervisor to steal or corrupt confidential data from other users in the cloud.

The research team has developed a new approach which builds upon existing hardware and firmware functionality to isolate sensi-

tive information and workload from the rest of the functions performed by a hypervisor. The new technique, called "Strongly Isolated Computing Environment" (SICE), demonstrates the introduction of a different layer of protection.

"We have significantly reduced the 'surface' that can be attacked by malicious software," says Ning. "Our approach relies on a software foundation called the Trusted Computing Base, or TCB, that has approximately 300 lines of code, meaning that only these 300 lines of code need to be trusted in order to ensure the isolation offered by our approach. Previous techniques have exposed thousands of lines of code to potential attacks. We have a smaller attack surface to protect."

SICE also lets programmers dedicate specific cores on widely-available multi-core processors to the sensitive workload - allowing the other cores to perform all other functions normally. Therefore, SICE is able to provide both high assurance for the sensitive workload and efficient resource sharing in a cloud.

In testing, the SICE framework generally took up approximately three percent of the system's performance overhead on multi-core processors for workloads that do not require direct network access. "That is a fairly modest price to pay for the enhanced security," Ning says. "However, more research is needed to further speed up the workloads that require interactions with the network." ■

## NC State to Collaborate on “Big Data” Initiative



Aiming to make the most of the fast-growing volume of digital data, the White House Office of Science and Technology Policy recently announced a **“Big Data Research and Development Initiative.”** By improving our ability to extract knowledge and insights from large and complex collections of digital data, the initiative promises to help solve some of the nation’s most pressing challenges.

To launch the initiative, six Federal departments and agencies are committing more than \$200 million that will greatly improve the tools and techniques needed to access, organize and glean discoveries from huge volumes of digital data.

NC State will collaborate with six research laboratories and six universities on a \$25

million, five-year project, the **Scalable Data Management, Analysis, and Visualization (SDAV) Institute.** SDAV is funded through the U.S. Department of Energy’s Scientific Discovery through Advanced Computing (SciDAC) program and will be led by Arie Shoshani of Lawrence Berkeley National Laboratory.

SDAV is a collaboration tapping the expertise of researchers at Argonne, Lawrence Berkeley, Lawrence Livermore, Los Alamos, Oak Ridge and Sandia national laboratories, and in seven universities: Georgia Tech, NC State, Northwestern, Ohio State, Rutgers, the University of California at Davis and the University of Utah. The SDAV will help researchers develop new tools to help scientists manage and visualize data on the Department of Energy’s (DOE) supercomputers, which will further streamline the processes that lead to discoveries made by scientists using the DOE’s research facilities. The need for these new tools has grown as the simulations running on the DOE’s supercomputers have increased in size and complexity.

NC State’s portion of the award is \$750,000. **Dr. Nagiza Samatova**, associate professor of computer science at NC State, is the co-PI on this project with **Dr. Anatoli Melechko**, associate professor in the Materials Science and Engineering Department. ■

## Data Defender - Unmasking Malware

The smartphone market is one of the fastest growing in the technology sector, and Android has the largest share of that market. So identifying malware that attacks Android users is becoming more and more important. **Dr. Xuxian Jiang**, an associate professor of computer science at NC State, has staked a claim as a leader in the field of malware detection.

Over the past 18 months, Jiang and his team of students identified at least 20 different pieces of malware in the official Android marketplace and in alternative markets that target Chinese users. He was the first to find such well-known malware as DroidKungFu and GingerMaster. His work on hunting down new malware has earned him an enormous amount of news coverage, from *Wired* magazine to *The Wall Street Journal*.

And last November, his team announced that some Android smartphones have incorporated additional features that can be used by hackers to bypass Android’s security features, making them more vulnerable to attack.

In addition to identifying malware, Jiang was also part of a team that developed new software called “Taming Information-Stealing Smartphone Applications (TISSA) to help



protect Android users from data theft. TISSA works by creating a privacy setting manager that allows users to customize the level of information each smartphone application can access.

Last year Jiang launched a formal collaboration with NetQin Mobile Inc., to better identify and monitor emerging mobile threats. NetQin is a leading global provider of consumer-centric mobile security and productivity applications. The collaboration not only recognizes Jiang’s earlier achievements and leadership, but also creates opportunities to better understand and monitor real-world mobile threats at scale – and develop next-generation mobile security solutions. ■

## White House Honors Sina Bahram as a “Champion of Change”

President Barack Obama recognized NC State graduate student **Sina Bahram** as one of 14 **“Champions of Change”** at a White House ceremony May 7, honoring those who have made significant efforts to make science, technology, engineering and mathematics (STEM) more accessible to people with disabilities.

Bahram, who earned his undergraduate and master’s degrees from NC State, is currently a Ph.D. student in computer science. His research focuses on improving the interaction between users and technology. This field of study is of particular importance to Bahram, who is blind.

“My goals are to use technology to facilitate access to all kinds of information for users with various functional limitations or specific needs,” Bahram says.

“Whether that’s allowing blind users to understand and interact with maps, flow charts, bar charts or graphs, or helping webpages become more accessible by providing content creators with the ability to check them against an automated system.”

Bahram has already developed a prototype system called **Touch It, Key It, Speak It (TIKISI)**, which allows computer users to access graphical information in an “eyes free” fashion. TIKISI can already be used to help blind users interact with Google Maps, and Bahram is working with other researchers to apply it to other materials, such as flow charts.

“When I was a child I made a conscious decision to have a positive outlook on life,” Bahram says. “That attitude has served me well. And when I began working on my Ph.D., I realized I had an opportunity to affect the kinds of changes I wished existed when I was younger and struggling to learn STEM topics. With TIKISI, I’m hoping to give low-income and under-privileged people access to these educational tools. This technology works with a smart phone or a tablet – you don’t need expensive, proprietary technologies that can be an obstacle for the disadvantaged.”

Bahram attributes his success, in part, to the support he’s received at NC State. “I have had some absolutely amazing professors,” Bahram says. ■



## NC State Computer Science

**Department Head** - Dr. Mladen Vouk

**Director of Graduate Programs** -  
Dr. Douglas Reeves

**Director of Undergraduate Programs** -  
Dr. Dennis Bahler

**Editor/Director of Development & External Relations** - Ken Tate

**Associate Editor** - Tammy Coates

### Contributing Writers

Tammy Coates, Nate DeGraff,  
Matt Shipman

### Photographers & Graphics

Becky Kirkland, Roger Winstead

### NC State University

#### Department of Computer Science

Campus Box 8206

Raleigh, NC 27695

Phone: 919-515-2858

Web: [www.csc.ncsu.edu](http://www.csc.ncsu.edu)

NC State University is committed to equality of educational opportunity and does not discriminate against applicants, students, or employees based on race, color, national origin, religion, sex, sexual orientation, age or disability. NC State University commits itself to positive action to secure equal opportunity regardless of those characteristics.

Copyright 2012. This document was produced by the NC State Department of Computer Science, with the financial support of the ePartners Program and the NC State Engineering Foundation, Inc.

No state funds were used; 2,200 copies of this document were printed at a total cost of \$732.

IMPACT is an update for business and academic leaders and contains edited versions of the original news stories. For complete stories and more news, please visit: [www.csc.ncsu.edu/news](http://www.csc.ncsu.edu/news)



Computer Science  
NC STATE UNIVERSITY

## Marshall Brain Recognized as College of Engineering 2011 Distinguished Alumnus

The College of Engineering at NC State recently named **Marshall D. Brain**, founder of HowStuffWorks.com, a **Distinguished Engineering Alumnus for 2011**. Brain, pictured here with Dean of the College of Engineering, Louis Martin-Vega, graduated from NC State in 1989 with a master's degree in computer science. Nine years later, he founded HowStuffWorks.com, an award-winning website that offers easy-to-understand explanations of how the world around us actually works. Brain created the website as a hobby, and as it grew, he carried it through several rounds of venture funding totaling approximately \$8 million. Discovery Communications purchased the site for \$250 million in 2007.



Brain is the author of more than a dozen books and has been a guest on TV and radio programs nationwide. He also hosted the National Geographic Channel's "Factory Floor with Marshall Brain," a show that gives viewers an inside look at how factories create products like airbags, tennis balls and fire extinguishers.

Prior to his career as a successful entrepreneur, Brain lectured in NC State's Department of Computer Science for six years, earning recognition as a member of the NC State Academy of Outstanding Teachers. He is currently serving as a Distinguished Engineering Alumnus lecturer in the Computer Science Department. He is teaching a class called "Enterprise Innovation" which will help students "develop an entrepreneurial mindset that allows ideas to move from the drawing board into the marketplace." ■

## Designing the Future of the Internet

NC State researchers are part of a team that will be designing a blueprint for a future version of the Internet, with funding from the National Science Foundation.

The research team's goal is to build a new architectural model for the Internet, which would foster innovation and make the Internet infrastructure more flexible, efficient and economically sustainable. The overarching grant funding is for \$2.7 million over the next three years. The lead research institution is the University of Massachusetts Amherst. Other institutions involved are NC State, the University of North Carolina at Chapel Hill and the University of Kentucky. NC State's funding under the grant is \$650,000 over three years.

The new Internet architecture will hinge on Internet users being able to make choices about which features and services they want to use, and which entities they want to pay to provide those services. "The NC State research team will be working on technology to enable users to be informed about available choices, and then exercise those choices," says **Dr. Rudra Dutta** (right), an associate professor of computer science at NC State and leader of the NC State effort. **Dr. George Rouskas** (left), a professor of computer science at NC State, is also part of the research team.



Specifically, Dutta says, NC State "will be working on designing and producing software that allows users to indicate their preferences in general terms, software that permeates the network to translate these preferences into concrete choices in many parts of the network, and an information exchange language allowing the two to interact, as users' data travels down the Internet." ■

The NC State team will also be working on technology that will measure network performance among different service providers, helping users understand the consequences of their preferences, thus helping them make more informed choices. ■