

# IMPACT IMPACT IMPACT IMPACT

## Researchers Devise More Accurate Method for Predicting Hurricane Activity

Researchers from NC State University have developed a new method for forecasting seasonal hurricane activity that is 15 percent more accurate than previous techniques.

“This approach should give policymakers more reliable information than current state-of-the-art methods,” says **Dr. Nagiza Samatova**, a professor of computer science and co-author of a paper describing the work. “This will hopefully give them more confidence in planning for the hurricane season.”

Hurricane predictions are challenging, in part, because there are an enormous number of variables in play – such as temperature and humidity – which need to be entered for different places and different times.

The trick is in determining which variables are most significant. This challenge is exacerbated by the fact that we only have approximately 60 years of historical data to plug into the models.

But now researchers have developed a “network motif-based model” that evaluates historical data for all of the variables in all of the places at all of the times in order to identify those combinations of factors that are most predictive of seasonal hurricane activity.

***“This approach should give policymakers more reliable information than current state-of-the-art methods.”***

The groups of important factors identified by the network motif-based model are then plugged into a program to create an ensemble of statistical models that present the hurricane activity for the forthcoming season on a probability scale.

Using cross validation – plugging in partial historical data and comparing the new method’s results to subsequent historical events – the researchers found the new method has an 80 percent accuracy rate of predicting the level of hurricane activity. This compares to a 65 percent accuracy rate for traditional predictive methods.



In addition, using the network model, researchers have not only confirmed previously identified predictive groups of factors, but identified a number of new predictive groups.

The researchers plan to use the newly identified groups of relevant factors to advance our understanding of the mechanisms that influence hurricane variability and behavior. This could ultimately improve our ability to predict the track of hurricanes, their severity and how global climate change may affect hurricane activity well into the future.

The paper, “Discovery of extreme events-related communities in contrasting groups of physical system networks,” was published last fall in the journal *Data Mining and Knowledge Discovery*. The paper is co-authored by Samatova; **Dr. Fredrick Semazzi**, a professor of marine, earth and atmospheric science at NC State; former NC State Ph.D. students **Zhengzhang Chen**, **William Hendrix**, and **Isaac Tetteh**; **Dr. Alok Choudhary** of Northwestern; and **Hang Guan**, a student at Zhejiang University. ■



### Inside this Issue

- Can Tracking Facial Expressions Improve Teaching Software? **2**
- Bitzer Inducted Into National Inventors Hall of Fame **3**
- Study Shows Software Developers’ Skills Improve Over Time **4**
- Computers Playing ‘Concentration’ Advances Security **5**
- Video Game Technology Steers Roaches on Autopilot **6**
- Using Technology to Influence Social Change **7**
- Game Design Program in the Top 15 - Again! **8**

Fall 2013 Issue

Computer Science

## Fornaro Receives IEEE Undergraduate Teaching Award

Congratulations to **Dr. Robert Fornaro**, professor of computer science at NC State, who has been selected to receive the **2013 Computer Science and Engineering Undergraduate Teaching Award** from the **IEEE Computer Society**. He was selected "for outstanding teaching and mentoring of undergraduate students in award-winning engineering projects."



The award is intended to highlight the Computer Society's commitment to undergraduate education, as well as affirm its support for excellence in undergraduate education.

Fornaro joined the Department in 1969 as one of its first Ph.D.s. He recently announced plans to enter phased retirement after serving as the Director of the NC State Computer Science Senior Design Center since 1994.

Fornaro developed the Center from its beginnings as an elective for students to complement their technical abilities by developing skills in teamwork, writing and speaking, to where it is today – a required part of the undergraduate curriculum for all computer science students. Three of the senior design teams advised and mentored by Fornaro went on to win international accolades for their efforts, including two first place finishes and one third place finish in the IEEE Computer Society International Design Competition (CSIDC). This was the first and only time in the history of CSIDC that students from any university in the world placed first in the competition in two consecutive years.

Fornaro received his B.A. in mathematics from St. Vincent College in Latrobe, PA, and his M.A. in mathematics (1965) and Ph.D. in computer science (1969) from Penn State, and joined the NC State Computer Science Department that same year. ■

## Can Tracking Facial Expressions Improve Teaching Software?

Research from NC State shows that software which tracks facial expressions can accurately assess the emotions of students engaged in interactive online learning and predict the effectiveness of online tutoring sessions.

"This work is part of a larger effort to develop artificial intelligence software to teach students computer science," says **Dr. Kristy Boyer**, assistant professor of computer science (pictured at right). "The program, JavaTutor, will not only respond to what a student knows, but to each student's feelings of frustration or engagement. This is important because research shows that student emotion plays an important role in the learning process."

***"This work is part of a larger effort to develop artificial intelligence software to teach students computer science.... Research shows that student emotion plays an important part in the learning process."***

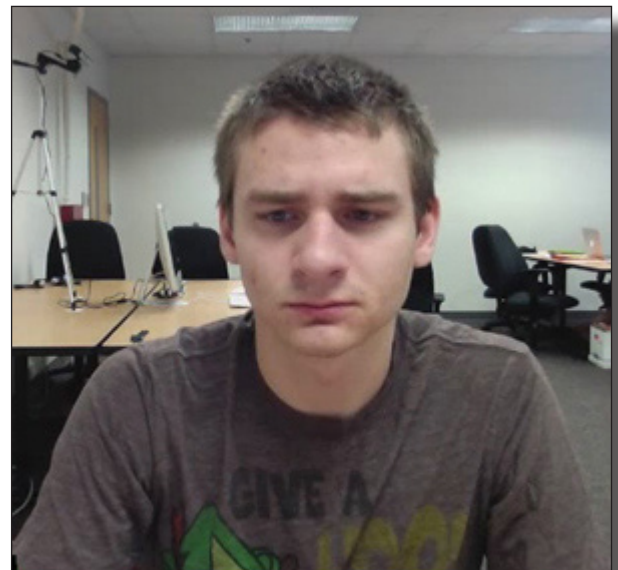
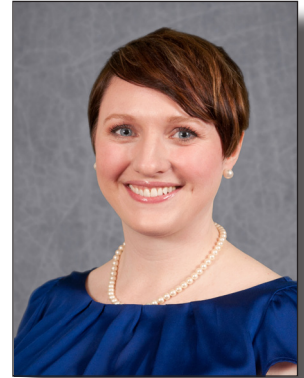
The researchers used the automated Computer Expression Recognition Toolbox (CERT) program to evaluate facial expressions of 65 college students engaged in one-on-one online tutoring sessions. The researchers found that CERT was able to identify facial movements associated with learning-centered emotions, such as frustration or concentration – and that the automated program's findings were consistent with expert human assessments more than 85 percent of the time.

The researchers also had the students report how effective they felt the tutorial was, and tested the students before and after each tutoring session to measure how much they learned.

The researchers used observational data from CERT along with student self-assessments and test results to develop models that could predict how effective a tutorial session was, based on what the facial expressions of the students indicated about each student's feelings of frustration or engagement.

"This work feeds directly into the next stage of JavaTutor system development, which will enable the program to provide cognitive and emotion-based feedback to students," says PhD student **Joseph Grafsgaard**.

The paper, "Automatically Recognizing Facial Expression: Predicting Engagement and Frustration," was presented at the International Conference on Educational Data Mining, on July 6-9 in Memphis, Tenn. The paper was co-authored by **Joseph Wiggins**, an undergraduate at NC State; **Dr. Eric Wiebe**, a professor of science, technology, engineering and math education at NC State; and **Dr. James Lester**, a professor of computer science at NC State. The research was supported by the National Science Foundation. ■



**Researchers automatically tracked facial expressions related to anxiety, confusion, engagement, and frustration. This expression is correlated with frustration.**

## Researchers ID Ways to Exploit 'Cloud Browsers' for Large-Scale, Anonymous Computing

Researchers from NC State and the University of Oregon have found a way to exploit cloud-based Web browsers, using them to perform large-scale computing tasks anonymously. The finding has potential ramifications for the security of "cloud browser" services.

At issue are cloud browsers, which create a Web interface in the cloud so that computing is done there rather than on a user's machine. This is particularly useful for mobile devices, such as smartphones, which have limited computing power. The cloud-computing paradigm pools the computational power and storage of multiple computers, allowing shared resources for multiple users.

"Think of a cloud browser as being just like the browser on your desktop computer, but working entirely in the cloud and providing only the resulting image to your screen," says **Dr. William Enck**, assistant professor of computer science.

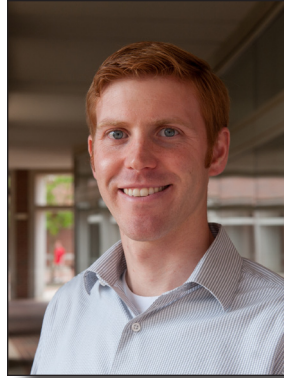
Because these cloud browsers are designed to perform complex functions, the researchers wanted to see if they could be used to perform a series of large-scale computations that had nothing to do with browsing. Specifically, the researchers wanted to determine if they could perform those functions using the "MapReduce" technique developed by Google, which facilitates coordinated computation involving parallel efforts by multiple machines.

The research team knew that coordinating any new series of computations would entail passing large packets of data between different nodes, or cloud browsers. To address this challenge, researchers stored data packets on bit.ly and other URL-shortening sites, and then passed the resulting "links" between various nodes.

Using this technique, the researchers were able to perform standard computation functions using data packets that were 1, 10 and 100 megabytes in size. "It could have been much larger," Enck says, "but we did not want to be an undue burden on any of the free services we were using."

"We've shown that this can be done," Enck adds. "And one of the broader ramifications of this is that it could be done anonymously. For instance, a third party could easily abuse these systems, taking the free computational power and using it to crack passwords."

However, Enck says cloud browsers can protect themselves to some extent by requiring users to create accounts – and then putting limits on how those accounts are used. This would make it easier to detect potential problems.



The paper, "Abusing Cloud-Based Browsers for Fun and Profit," was presented Dec. 6, 2012, at the 2012 Annual Computer Security Applications Conference in Orlando, Fla. The paper was co-authored by **Vasant Tendulkar** and **Ashwin Shashidharan**, graduate students at NC State, and **Joe Pletcher, Ryan Snyder** and **Dr. Kevin Butler**, of the University of Oregon. The research was supported by the National Science Foundation and the U.S. Army Research Office. ■

### Extraordinary Women Become SHE++ Mentors

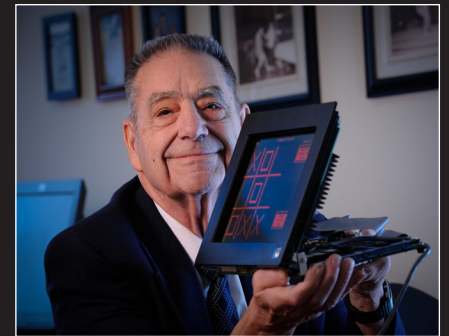
Five NC State Computer Science students and alumnae have been selected as mentors/role models in SHE++, a Stanford University initiative whose goal is to foster a community to inspire a new generation of female programmers. The purpose of the program is to encourage girls to explore computer science, to demystify the computer science major to high school and middle school students and to bridge connections between young leaders, and inspire students. The group's initiatives include connecting technically-inclined high school and middle school girls with upper level female college students and recent graduates in computer science via online video conversations several times a month.

NC State's participants include: undergraduate **Kamaria Hardy**, PhD student **Piyali Dey**, and alumnae **Dr. Bushra Anjum, Pamela Ocampo**, and **Andrea Villanes**. ■

## Bitzer Inducted into National Inventors Hall of Fame

**Dr. Donald L. Bitzer**, who helped develop the technology behind the plasma-screen televisions that sit in millions of living rooms, has been inducted into the National Inventors Hall of Fame. Bitzer is Distinguished University Research Professor of Computer Science at North Carolina State University.

The Hall of Fame, which was founded in 1973, honors inventors whose innovations and entrepreneurial endeavors have changed the world. Its membership includes Thomas Edison, Wilbur and Orville Wright, Alexander Graham Bell and Steve Jobs.



Bitzer co-invented the flat plasma display panel in 1964. The invention was originally designed as an educational aid that made it more comfortable for students to work in front of computers for long periods of time, as plasma screens do not flicker. The technology was eventually applied to television screens, and millions of plasma TVs have been sold to the public since their introduction in the 1990s.

Bitzer is also known as the "Father of PLATO," or Programmed Logic for Automatic Teaching Operations, the first computer system to combine graphics and touch-screen displays. His work on the technology began around 1960; descendant systems still operate today.

In 2002, Bitzer received an Emmy Award from the National Academy of Television Arts and Sciences for his work advancing television technology. He has been a member of the National Academy of Engineering since 1974.

Bitzer received his bachelor's, master's and doctoral degrees in electrical engineering in 1955, 1956, and 1960, respectively, from the University of Illinois at Urbana-Champaign. He joined the faculty at NC State in 1989. ■

## Savage Named Secretary, Fellow of AMS

**Dr. Carla Savage**, professor of computer science in the NC State Computer Science Department, has been named **Secretary** of the **American Mathematical Society (AMS)**, effective February 1, 2013. In the years since the Society was formed in 1888, there have only been nine secretaries; Savage becomes the tenth.



The Office of the Secretary is the primary point of contact between the AMS and its 30,000 members. The Secretary implements scientific policies of the

Society, oversees the scientific program of AMS Conferences (9-10 per year), manages the AMS Committee Structure (over 120 committees), oversees 30 AMS Prizes and Awards and the AMS Fellows Program, coordinates the annual AMS Elections, and serves to maintain the institutional memory of the Society.

The Secretary also serves as an Officer of the Society and a member of the AMS Council. As such, she participates in all governance activities and in formulating policy for the Society. She also serves as Chair of the five-member Secretariat, which oversees the scientific program of the ten annual AMS Conferences.

In addition to being named Secretary, Savage was invited to join the inaugural class of **Fellows of the American Mathematical Society (AMS)**. She joins mathematical scientists from around the world who have been named Fellows for 2013, the program's initial year. This inaugural class of 1,119 Fellows represents over 600 institutions.

The Fellows of the AMS designation recognizes members who have made outstanding contributions to the creation, exposition, advancement, communication, and utilization of mathematics. Founded in 1888 to further mathematical research and scholarship, the 30,000-member American Mathematical Society fulfills its mission through programs and services that promote mathematical research and its uses, strengthen mathematical education, and foster awareness and appreciation of mathematics and its connections to other disciplines and everyday life. ■

## Older is Wiser: Study Shows Software Developers' Skills Improve Over Time

There is a perception in some tech circles that older programmers aren't able to keep pace with rapidly changing technology, and that they are discriminated against in the software field. But a new study from NC State indicates that the knowledge and skills of programmers actually improve over time – and that older programmers know as much (or more) than their younger peers when it comes to recent software platforms.

"We wanted to explore these perceptions of veteran programmers as being out of step with emerging technologies and see if we could determine whether older programmers are actually keeping up with changes in the field," says **Dr. Emerson Murphy-Hill**, assistant professor of computer science. "And we found that, in some cases, veteran programmers even have a slight edge."

The researchers looked at the profiles of more than 80,000 programmers on a site called StackOverflow, which is an online community that allows users to ask and answer programming questions. The site also allows users to rate the usefulness of other users' questions and answers. Users who are rated as asking good questions and providing good answers receive points that are reflected in their "reputation score." The higher an individual's reputation score, the more likely it is that the user has a robust understanding of programming issues.

For the first part of the study, the researchers compared the age of users with their reputation scores. They found that an individual's reputation increases with age, at least into a user's 40s. There wasn't enough data to draw meaningful conclusions for older programmers.



The researchers then looked at the number of different subjects that users asked and answered questions about, which reflects the breadth of their programming interests. The researchers found that there is a sharp decline in the number of subjects users weighed in on between the ages of 15 and 30 – but that the range of subjects increased steadily through the programmers' 30s and into their early 50s.

Finally, the researchers evaluated the knowledge of older programmers (ages 37 and older) compared to younger programmers (younger than 37) in regard to relatively recent technologies – meaning technologies that have been around for less than 10 years.

For two smartphone operating systems, iOS and Windows Phone 7, the veteran programmers had a significant edge in knowledge over their younger counterparts. For every other technology, from Django to Silverlight, there was no statistically significant difference between older and younger programmers.

"The data doesn't support the bias against older programmers – if anything, just the opposite," Murphy-Hill says. ■

## Faster Downloads for Smartphones

Tired of waiting around for your smartphone to play that video? NC State computer scientists have good news: Faster downloads are coming soon.

**Dr. Injong Rhee**, a professor of computer science, has helped develop a new algorithm that cuts down data retrieval time for the software programs that power smartphones and tablets.

These mobile devices use "transmission control protocol (TCP) stacks," programs that send and receive packets of data between the device and the network. With help from **Dr. Kyunghan Lee**, a former senior research associate at NC State who is now an assistant professor at the Ulsan National Institute of Science and Technology in South Korea,

Rhee demonstrated that the new algorithm makes the stacks more efficient.

That makes the user experience a whole lot better.

The researchers plan to use the Chancellor's Innovation Fund (CIF) money to quantify that improved efficiency on various network providers using several smartphone and tablet brands. They're also creating a business strategy for US markets. Eventually they want to expand to Asia.

"This technology will help make the smartphone and tablet experience much more enjoyable for users," Rhee said. "And the CIF funding will help convince network providers that it really works." ■

## Teaching a Computer to Play 'Concentration' Advances Security, Understanding of the Human Mind

Computer science researchers have programmed a computer to play the game Concentration (also known as Memory). The work could help improve computer security – and improve our understanding of how the human mind works.

The researchers developed a program to get the software system called ACT-R, a computer simulation that attempts to replicate human thought processes, to play Concentration. In the game, multiple matching pairs of cards are placed face down in a random order, and players are asked to flip over two cards, one at a time, to find the matching pairs. If a player flips over two cards that do not match, the cards are placed back face down. The player succeeds by remembering where the matching cards are located.

The researchers were able to either rush ACT-R's decision-making, which led it to play more quickly but make more mistakes, or allow ACT-R to take its time, which led to longer games with fewer mistakes.

The findings will help the researchers distinguish between human players and automated "bots," ultimately helping them develop models to identify bots in a variety of applications. These bots pose security problems for online games, online voting and other Web applications.

"One way to approach the distinction between bot behavior and human behavior is to look at how bots behave," says **Dr. Robert St. Amant**, associate professor of computer science. "Another way is to look at what humans do. We're focusing on the latter."



"We're looking for distinctions so subtle that they'd be very difficult to replicate outside of a cognitive architecture like ACT-R," says **Dr. David Roberts**, assistant professor of computer science.

***"This is information that moves us incrementally closer to understanding how cognitive function relates to the way we interact with computers"***

The researchers were also able to modify the parameters of their Concentration model to determine which set of variables resulted in gameplay that most closely matched the gameplay of the human study participants.

This offers a plausible explanation of the cognitive processes taking place in the human mind when playing Concentration. For example, the Concentration model sometimes has a choice to make: remember a previous matching card and select it, or explore the board by selecting a new card. When playing for speed, the model takes the latter choice because it's faster than retrieving the information from memory. This may also be what's happening in the human brain when we play Concentration.

"This is information that moves us incrementally closer to understanding how cognitive function relates to the way we interact with computers," Roberts says. "Ultimately, this sort of information could one day be used to develop tools to help software designers identify how their design decisions affect the end users of their products. For example, do some design features confuse users? Which ones, and at what point? That would be useful information."

The paper, "Modeling the Concentration Game with ACT-R," was presented at the International Conference on Cognitive Modeling, on July 11-14 in Ottawa. Lead author of the paper is **Titus Barik**, a Ph.D. student at NC State. Co-authors include St. Amant, Roberts, and NC State Ph.D. students **Arpan Chakraborty** and **Brent Harrison**. The research was supported by the National Security Agency, mobile threats at scale – and develop next-generation mobile security solutions. ■

## Enck, Murphy-Hill Receive NSF CAREER Awards



Congratulations to **Drs. William Enck** and **Emerson Murphy-Hill** (pictured above) on receiving **Faculty Early Career Development (CAREER) Awards** from the **National Science Foundation (NSF)**.

**Enck's award, valued at \$400,000, supports his proposal titled, "Secure OS Views for Modern Computing Platforms."** **Murphy-Hill's award, valued at \$495,721, supports his proposal titled, "Expanding Developers' Usage of Software Tools by Enabling Social Learning."**

**The NC State Computer Science Department now has 24 NSF CAREER Award winners (21 currently on faculty), one of the highest concentrations of any department in the nation. ■**

## Young Named Senior Member of AAAI

**Dr. R. Michael Young** (pictured below) was recently awarded **Senior Member status of the Association for the Advancement of Artificial Intelligence (AAAI)**.



**Senior member status was established to recognize AAAI members who have achieved significant accomplishments within the field of artificial intelligence. ■**

## Impact Bytes



**Dr. James C. Lester** has been named **Distinguished Professor in Computer Science at NC State**. Lester's research focuses on transforming education with technology-rich learning environments.

Congratulations to **Dr. Injong Rhee** on having his co-authored paper, "On the Levy-Walk Nature of Human Mobility," selected to receive the **2013 IEEE Communications Society William R. Bennett Prize in the Field of Communications Networking**.



**Dr. Rada Chirkova** was named a **Senior Member of the Association for Computing Machinery (ACM)**.

**Drs. Rada Chirkova, Vince Freeh, Christopher Healey, Mladen Vouk, and Laurie Williams** received **2012 IBM Faculty Awards**.

In 2012, the Apache Software Foundation board voted to graduate the **NC State Virtual Computing Lab (VCL)** from the Apache Incubator to an **Apache TLP (Top Level Project)**.

**Dr. Robert St. Amant** received the **2013 Outstanding Teacher of the Year** from the College of Engineering. ■



## Researchers Use Video Game Technology to Steer Roaches on Autopilot

North Carolina State University researchers are using video game technology to remotely control cockroaches on autopilot, with a computer steering the cockroach through a controlled environment. The researchers are using the technology to track how roaches respond to the remote control, with the goal of developing ways that roaches on autopilot can be used to map dynamic environments – such as collapsed buildings.



The researchers have incorporated Microsoft's motion-sensing Kinect system into an electronic interface developed at NC State that can remotely control cockroaches. The researchers plug in a digitally plotted path for the roach, and use Kinect to identify and track the insect's progress. The program then uses the Kinect tracking data to automatically steer the roach along the desired path. Video of the system in action is available here.

The program also uses Kinect to collect data on how the roaches respond to the electrical impulses from the remote-control interface. This data will help the researchers fine-tune the steering parameters needed to control the roaches more precisely.

"Our goal is to be able to guide these roaches as efficiently as possible, and our work with Kinect is helping us do that," says **Dr. Alper Bozkurt**, an assistant professor of electrical and computer engineering at NC State and co-author of a paper on the work.

"We want to build on this program, incorporating mapping and radio frequency techniques that will allow us to use a small group of cockroaches to explore and map disaster sites," Bozkurt says. "The autopilot program would control the roaches, sending them on the most efficient routes to provide rescuers with a comprehensive view of the situation."

The roaches would also be equipped with sensors, such as microphones, to detect survivors in collapsed buildings or other disaster areas. "We may even be able to attach small speakers, which would allow rescuers to communicate with anyone who is trapped," Bozkurt says.

Bozkurt's team had previously developed the technology that would allow users to steer cockroaches remotely, but the use of Kinect to develop an autopilot program and track the precise response of roaches to electrical impulses is new.

The interface that controls the roach is wired to the roach's antennae and cerci. The cerci are sensory organs on the roach's abdomen, which are normally used to detect movement in the air that could indicate a predator is approaching – causing the roach to scurry away. But the researchers use the wires attached to the cerci to spur the roach into motion. The wires attached to the antennae send small charges that trick the roach into thinking the antennae are in contact with a barrier and steering them in the opposite direction.

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***"We want to build on this program, incorporating mapping and radio frequency techniques that allow us to use a small group of cockroaches to explore and map disaster sites."***

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The paper, "Kinect-based System for Automated Control of Terrestrial Insect Biobots," was presented at the Remote Controlled Insect Biobots Minisymposium at the 35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society July 4 in Osaka, Japan. Lead author of the paper is NC State undergraduate **Eric Whitmire**. Co-authors are Bozkurt and NC State graduate student **Tahmid Latif**. The research was supported by the National Science Foundation. ■

## Using Technology to Influence Social Change

"Field of Dreams," a popular movie in the late 1980's, coined the phrase "If you build it, they will come," meaning that people don't realize they want or need something until it is right in front of them. Today's most relevant way to build a field of dreams is to integrate technology into subject matter, which is just what NC State computer science students **Khalia Braswell** and **KaMar Galloway** have done. Their collaboration with **Dr. Fay Cobb Payton** on a critical healthcare outreach effort is changing mindsets, increasing communication and bringing people together to talk like never before.

Payton, associate professor of Information Systems at NC State, recognized a troublesome trend in minority college students with regards to staying educated on HIV/AIDS. Because of the divide she saw, Payton enlisted the help of Braswell and Galloway, to create her own field of dreams, known as **myhealthimpactnetwork.org**. The interactive health website focuses on health care issues and disparities that target Black female college students, in particular, and college-aged students, in general.

Payton suspected that the stigma associated with the disease had an impact on the problem of educating women on the disease. To combat this issue, Braswell and Galloway brought in their expertise of communicating with students of their generation via technology. With their insight into the target population and their experience with social change through the use of social media, the project took on a relevance that was a perfect match for the group they were trying to target.

"When we started putting the site together, I figured people would want statistics, but from our data-gathering sessions, we found that people really wanted testimonials from people with this health issue," said KaMar Galloway. "If someone can identify with another person's experience, then the numbers really don't matter as much."



**my health impact**  
NETWORK

Braswell readily agreed. "We knew the impact that social media has on social change and we wanted to engage the students through the website," she said. "We initially thought that because of the subject matter, people might be hesitant to participate, but we found through the blog portion of the site that people really responded to other's experiences and concerns."

The team's goal was to put highly relevant messages out in the most current and popular forms of communication among their targeted group, in hopes that the information would impact behaviors and promote prevention. The team found that most Black college-age females found current HIV/AIDS websites to be either stereotypical or too heavily written in medical jargon.

Not only was the current information not representative of the population the team was trying to reach, they also found that there were many social barriers keeping the population from effectively educating themselves on the issue, such as pressure from family, the faith-based community and even a mistrust of the health care community.

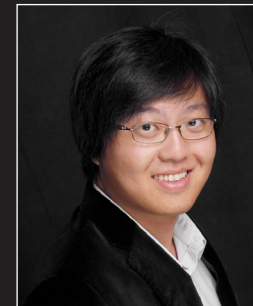
So with social and cultural stigmas attached to this disease, how did the students seek to break down such well-entrenched barriers?

"We have connections to the students who are using the site," Braswell said. "They know us and trust us and are interested in reading about what we are blogging about, which is very timely information about HIV/AIDS. We write about real experiences that are happening to people we know. Because they know us, they are having the courage to ask for more information and to tell us more of what they need to see on the site to help them make good decisions."

Follow the project on Twitter @myhealthimpact or contact Dr. Payton at fay\_payton@ncsu.edu. ■

## Impact Bytes

Four students from the NC State Computer Science Department were chosen to receive prestigious and highly competitive **National Science Foundation (NSF) Graduate Research Fellowships**. The Department's winners include: **Joseph Arthur, Brittany Johnson, Fernando Rodriguez, and Neil Shah**. Fellows benefit from three years of funding (approximately \$122,500) for research-focused degrees in science, technology, engineering and mathematics fields.



**Zhe Zhang, a PhD student in the Computer Science Department, was awarded a prestigious 2013 IBM PhD Fellowship Award. Fellows are awarded**

**tuition, fees, and a stipend for one academic year. Earlier this academic year, Zhang also received a IBM PhD Watson Solutions Scholarship. This is a \$10,000 award that can be used for educational purposes such as, but not limited to, tuition, conference travel, etc.**

**Congratulations to recent Computer Science graduate KaMar Galloway on being chosen to participate in the Google Computer Science Teaching Fellows Practicum. His area of focus is K-12 computer science education. Google seeks our talented Science, Technology, Engineering or Math (STEM) teachers to join this two-year program designed to grow leaders in computer science.**

**Recent Master's Degree graduate Andrea Villanes won an Anita Borg Systems Pass-It-On Award for her project titled "Reaching Out**



**Peru!" Villanes' \$1,000 award will go toward organizing two events in Peru to help girls learn more about computer science. ■**

## NC State Computer Science

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Computer Science  
NC STATE UNIVERSITY

## NC State's Video Game Design Program in Top 15

NC State has been recognized as one of the top 15 undergraduate programs to study video game design on The Princeton Review's fourth annual list saluting the best schools in the U.S. and Canada. This is the third year in a row that NC State's program has been recognized.

The list, "Top Schools to Study Video Game Design for 2013," is based on a survey The Princeton Review conducted in 2012-13 of 150 programs at institutions in the US and Canada offering video game design coursework and/or degrees. Overall, the list salutes 50 game design programs (30 undergraduate/20 graduate) at 35 institutions.

Criteria for The Princeton Review's school selections covered the quality of the curriculum, faculty, facilities and infrastructure. They also factored in data it collected from the schools on their scholarships, financial aid and career opportunities.

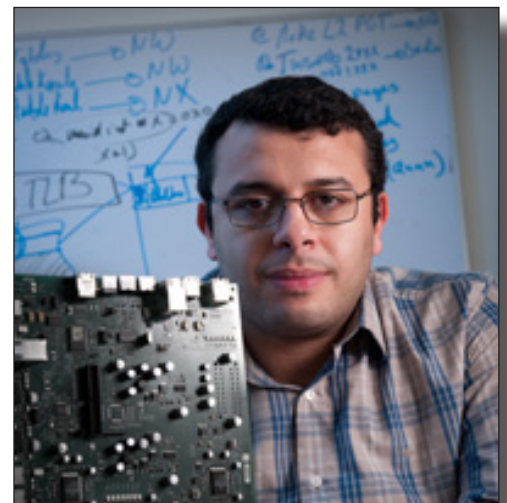


**Dr. R. Michael Young**, professor of computer science and director of the Digital Game Research Center at NC State said, "After three years being ranked in the top 30 game programs, we're very excited to be ranked #15 in North America by The Princeton Review for 2013. It's a reflection of the strong academic programs we have in games here at NCSU and of the impact that our graduates are having at leading games companies like Epic Games, Red Storm Entertainment and many others. NC State has a unique program that blends games courses taught in world-class engineering and design colleges. Instructors work with games industry leaders like Electronic Arts, Zynga, Microsoft Game Studios and many others to ground class work in real-world practices. As a result, our graduates are trained as excellent software developers or designers with all the tools they need to hit the ground running at a game company. Our graduates land jobs at large, international companies like Epic Games, dynamic North Carolina game studios like Spark Plug Games or start-ups that they found themselves, like Mighty Rabbit Studios." ■

## Protecting the Cloud

NC State has been recognized as one of the top 15 schools in the world for research in the heart of cloud computing is the hypervisor, software that allows multiple users to run programs concurrently on a host computer. But if a malicious program gains access to the hypervisor, the data held by all those users could be changed or stolen.

**Drs. Ahmed Azab** (pictured at right) and **Peng Ning** have devised a solution. They've developed a new security mechanism called HyperSentry that is isolated and protected from the hypervisor but retains enough privileges to search the hypervisor code and data for viruses and other malware. The researchers hope their tool can be adopted on large servers, PCs and mobile phones to help keep these devices secure.



Through Chancellor's Innovation Fund (CIF) funding, Azab, a senior research associate in the Department of Computer Science, and Ning, a professor of computer science, are teaming with a company called Innovalyst that is helping to commercialize HyperSentry. Innovalyst has linked the researchers to key personnel in software and hardware companies who could be future customers.

with venture capitalists and investors who have evaluated HyperSentry's commercialization potential. These connections kept the researchers updated on what the industry actually needs.

"The CIF is not just about the money," Azab said. "It is also about the support that the inventors get to commercialize products." ■

In addition, the university's Office of Technology Transfer helped the researchers connect