

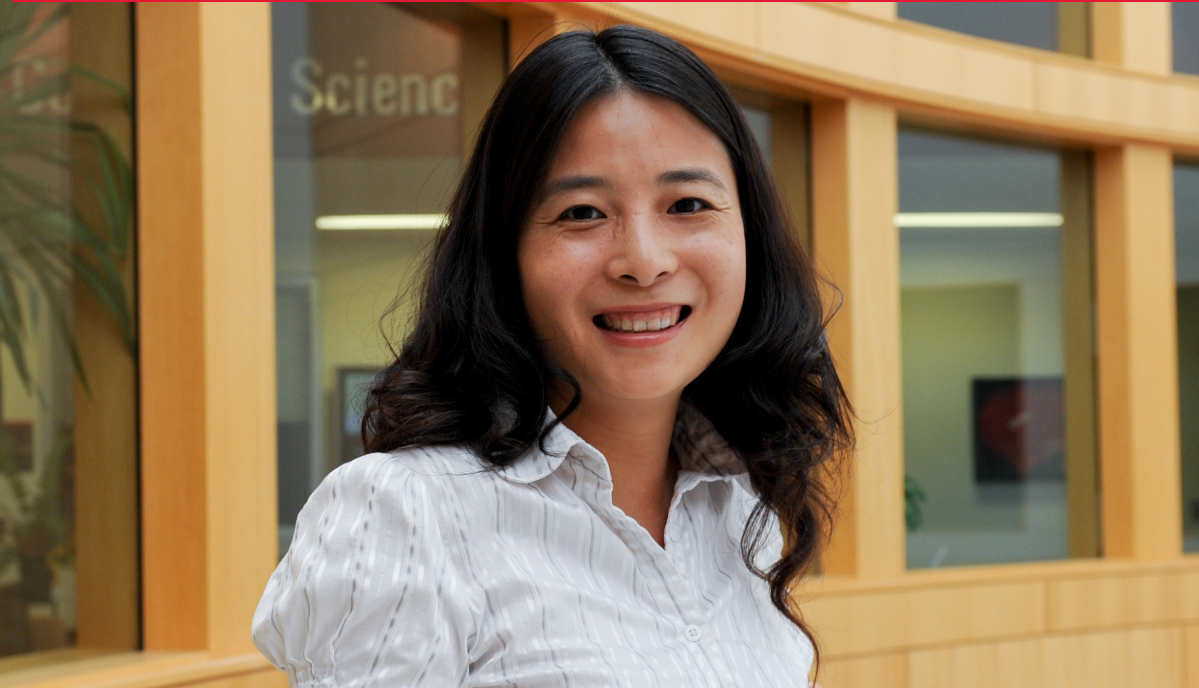
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# IMPACT

New Tech to Help Companies Detect and Respond to Cloud Computing Performance Bugs

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In late 2012, **Helen Gu** presented a research paper on a new tool designed to prevent disruptions in cloud computing. Less than four years later, she has launched a start-up to help companies that use cloud computing improve the user experience for their customers.

"The technology I developed has evolved significantly since 2012," says Gu, an associate professor of computer science at NC State University. "What was then a proof-of-concept is now a technology that works seamlessly with real-world cloud systems, like Amazon Web Services, with a click of a button."

Gu's technology allows companies that use cloud computing to gain insight into user and program behavior in order to diagnose potential problems in their code, so that it can be corrected quickly. The technology can also prevent performance disruptions in cloud-hosted applications by automatically identifying and responding to potential anomalies before they can develop into disastrous service outages.

"What we're doing is important, because services like Spotify and Snapchat are constantly deploying updates to their code," Gu explains. "Our technology can help these companies prevent or detect problems in the updated code and, ultimately, improve the user experience."

"I launched my start-up, InsightFinder Inc., to make this technology available to companies – like Snapchat or Netflix – that use the cloud to deliver their services."

In 2013, NC State's Office of Technology Transfer filed for a patent on the technology. Gu started InsightFinder last November.

The start-up was made possible by a highly competitive National Science Foundation Small Business Innovation Research grant that Gu is using to develop, test and fine-tune prototypes.

"Our first public-facing prototype – our beta version – is available for free, for limited testing," Gu says. "But ultimately, we'll be offering three subscription-based services to corporate customers."

InsightFinder's three services are: a basic cloud-monitoring service; a premium smart monitoring service, which she says is more powerful and accurate than existing products on the market based on real-world application testing with a pilot customer; and a batch data analysis service that allows customers to upload historical data to get insights on what caused a performance problem in the past.





## Microsoft Research Names Dr. Laurie Williams Outstanding Collaborator

**Dr. Laurie Williams**, Associate Department Head and Professor in the NC State Computer Science Department, recently received one of 32 **Microsoft Research Outstanding Collaborator Award** for 2016.

The Microsoft Research Outstanding Collaborator Awards highlight and celebrate some of the amazing academics who have worked with Microsoft Research over the years.

Per Williams' biography in the Outstanding Collaborator Award Booklet, "Williams has made exceptional contributions to software engineering research not only in Microsoft Research (MSR) but throughout Microsoft at unprecedented levels for over 10 years. She has collaborated and continues to work with a wealth of Microsoft researchers spanning several continents on a number of research projects, ranging from continuous deployment, software security, agile development, software engineering, software analytics, and many others. She has helped Microsoft product teams including Windows Client and Server, DevDiv, Bing, Skype, and Yammer. Her collaboration with MSR has led to many highprofile publications as well as book projects, and she has helped organize joint research and product group seminars on branching. Laurie's collaboration has involved many students and interns who, like her, have continued to make a positive impact at Microsoft and the software engineering research community. Laurie has been an inspiration for empirical software engineering at Microsoft."

## In Gaming, Player Behavior Reflects Roles - Even When No Roles are Given

New research from NC State finds that player behavior in narrative role-playing games (RPGs) reflects specific character roles – even if the game tells players nothing about the character's role. The finding is relevant to both game designers and gaming researchers who study player behavior in RPGs.

"We wanted to know how, if at all, having a role influenced player behavior," says **Ignacio Domínguez**, lead author of a paper on the work and a computer science Ph.D. student at NC State. "We also wanted to know if it mattered whether the role was assigned versus selected by the player.

"We found that people's behavior was consistent with their role, regardless of whether it was assigned or chosen," Domínguez says. "What's more, we found that people's gameplay was consistent with a single role even if they didn't have one. In other words, people exhibit consistent, role-based behavior even if they are given no information about what their role should be."

For the study, researchers created a simple, single-player RPG. The RPG is a visual, interactive narrative game, but offers no cues about the physical attributes of the player character. (The game can be found online at <http://go.ncsu.edu/ixd-demo-rpg>).

The researchers had 210 people play the game, and tracked their gameplay. Seventy-eight players were assigned to one of three roles: fighter, mage, or rogue; 91 players were allowed to choose from the three roles; and 41 players were given no role – they simply began gameplay.

The gameplay consisted of not only moving the character through the game environment, but also making a dozen multiple choice decisions about the character's actions in an unfolding fictional narrative.

Each option within every multiple choice decision was designed to be consistent with one of the three character roles. For example, when players are asked to select a weapon, they can choose from an axe (which is consistent with the "fighter" role), a staff (mage), or a set of daggers (rogue).

After evaluating the players' decisions, researchers found that – whether roles were assigned or chosen – player behavior was very consistent with their explicit roles. Players, with fighter roles, for example, chose the "fighter" options on decision-making tasks 65.7 percent of the time. Mages chose the "mage" options 76.1 percent of the time, while rogues chose the "rogue" options 69.7 percent of the time.

"The results strongly support the idea that players make choices based on their character's role, even if they didn't pick the role," says **David Roberts**, an associate professor of computer science at NC State and senior author of the paper. "And we were careful, when creating the game, to validate the role descriptions we provided to players, as well as validating that all of the gameplay options were perceived consistently with the relevant roles."

The researchers also assessed the gameplay of players who were given no information about their characters' roles, to see if player decisions tended to be consistent with a role anyway. They did this using cluster analysis, which told them how often player decisions tended to cluster around a specific role.

"We found that, even when players were not explicitly given a role, participants still role-played," says **Rogelio Cardona-Rivera**, co-author of the paper on the work and a computer science Ph.D. student at NC State. That is, players who were told nothing about their character still tended to make gameplay decisions as if the character had been specifically defined as a fighter, mage or rogue.

"Our study is also interesting from a narrative perspective, because it sheds light into how players cast themselves as characters in an unfolding narrative during gameplay," Cardona-Rivera says.

"Our findings could have two main uses," Domínguez says. "First, it tells game designers that they may want to focus their content development efforts on actions consistent with character roles, and spend less time on content that players are unlikely to use.

"Second, the study highlights the fact that researchers studying gaming and player choice need to account for roles within games, or else their findings may be skewed," Domínguez says.

## New Computer Science Corporate and Career Services Suite Opens in EB2

The NC State Department of Computer Science proudly announces the appointment of **Leslie Rand-Pickett** as Director of Graduate Career Services, along with the launch of the new **Computer Science Corporate & Career Services Suite** located at suite 1222 in Engineering Building 2 (EB2).

In this newly created role, Rand-Pickett will liaison with industry partners as an advocate for the department to encourage and identify premiere internship and career opportunities for our grad students. She will also serve as the primary mentor for professional skills development for our grad students, helping students create professional development plans, while providing resources across a variety of media and touch points to enable students to achieve their goals.

The new Director of Graduate Career Services position and the Career Services Suite are an integral part of our continuing efforts to enhance our students' experience in and out of the classroom. **Dr. George Rouskas**, Professor & Director of Graduate Programs says, "We are very happy to provide this type of value-add service to our 700+ graduate students. While our students are already highly sought after, we believe this focused

support will provide our students with an even stronger foundation for professional success." Rouskas adds, "Leslie will also be working closely with our PhD students to help them formulate career plans, whether that be a corporate or academic interest."

**Ken Tate**, Director of Engagement & External Relations adds that the new Career Services Suite will be a tremendous addition to the department's robust industry partnership toolkit. "This provides us an opportunity to complement and enhance the services provided by the University Career Development Center, giving access to partners through dedicated interview rooms on Centennial Campus, near our students." Tate adds, "This will position us to pursue deeper and more meaningful partnerships with companies looking for the very best computer science talent."

The new 700 sf Corporate and Career Services suite is located on the first floor of Engineering Building 2 (EB2). In addition to office space, it contains two high-tech interview rooms with HD monitors and connections to support video capabilities for remote interviews. ePartners with the department will have priority access to the space.

## Department Announces Graduate Certificate in Data Sciences

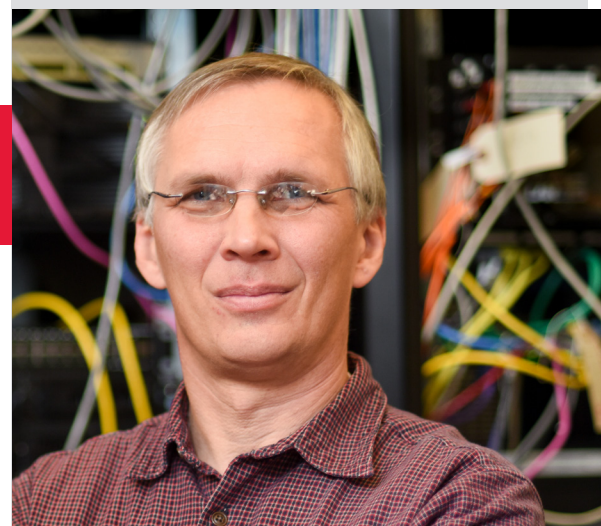
The Department of Computer Science at NC State University is pleased to announce the approval and launch of a Master Track in Data Science in the Computer Science Graduate Program curriculum. The curriculum became effective in Fall 2015.

Data Science has become increasingly important in nearly every industry sector and academic field, and the discovery and forecasting of insightful patterns from "Big Data" is at the core of analytical intelligence in government, industry, and science.

According to **Dr. George Rouskas**, Professor & Director of Graduate Programs, "The Masters Track in Data Science complements various academic and research initiatives in data science

on campus." He adds that the track will provide students with the skills essential to knowledge discovery efforts to identify standard, novel and truly differentiated solutions and decision-making, including skills in managing, querying, analyzing, visualizing, and extracting meaning from extremely large data sets.

The data sciences track curriculum requirements include nine credit hours of data science core courses; nine credit hours of data science electives; twelve credit hours of computer science core courses, graduate electives or restricted electives; and a one credit hour orientation course, for a total of 31 credit hours. Students must also satisfy all the Master of Computer Science (MCS) requirements.



## Mueller Honored as IEEE Fellow for Achievements in Timing Analysis Research

**Dr. Frank Mueller**, professor of Computer Science at NC State, has received a distinguished honor from the Institute of Electrical and Electronics Engineers (IEEE), by being voted an IEEE Fellow for his contributions to real time, embedded systems, and timing analysis research.

Mueller is known for his creativity of constructing his own supercomputing environment by using multiple Sony PS3 gaming units. His creative construction was featured in a segment of National Public Radio in 2007.

"It was supercomputing on the cheap," he said. "It is perfect for the educational setting, where we are always looking for ways to do things without having additional funding. By networking multiple PS3 gaming units together with LINUX, I was able to recreate a computer scenario similar to large scale computing in a lab."

Originally from Germany, Mueller completed his undergraduate work at the Technical University of Berlin and earned his Master's and PhD degrees from Florida State University.

Mueller is now the seventh IEEE Fellow in his department, joining Drs. George Rouskas, Harry Perros, Donald Bitzer, Wushow "Bill" Chou, Mladen Vouk, and Munindar Singh, who have been selected between the years of 1982-2011.

## Researchers Eye Gaming As Tool for Boosting Computer Science Skills, Diversity in Middle Schools

An interdisciplinary team of researchers from NC State and the University of Florida is launching an initiative that will use a custom-designed video game to boost computational thinking in middle school science classrooms. The goal is not only to improve educational outcomes, but also to foster gender and racial diversity in computer science and other science, technology, engineering and mathematics (STEM) fields.



of STEM education at NC State and co-principal investigator (co-PI) on the project.

“To that end, the next generation science education standards include a set of practices to be incorporated into K-12 classrooms,” says Wiebe, who is also a senior research fellow at the Friday Institute for Educational Innovation. “One of those practices is computational thinking – which has only been loosely defined. Broadly speaking, it’s a set of mental processes that can be used to solve problems. It involves everything from computing tools and coding to disciplines such as data analytics.”

“Our goal isn’t to encourage every student to become a computer scientist,” says **Bradford Mott**, a senior research scientist at NC State and co-PI on the project. “We want students to understand how to utilize computer science principles

in any field, regardless of what careers they choose to pursue.”

And the project isn’t starting from scratch. The researchers spent years designing and developing a game called Engage –also with NSF support – which will serve as the jumping off point for the new initiative.

“We have already tested Engage in North Carolina middle schools, and have a lot of empirical data demonstrating its

effectiveness as an educational tool,” says **James Lester**, a Distinguished Professor of Computer Science at NC State and lead PI on the project. “Our goal now is to build on Engage, to continue providing an excellent science education curriculum that deeply integrates computational thinking.”

But addressing computational thinking and life sciences are not the only goals. The researchers also want the game to support diversity in STEM education and, ultimately, in the STEM workforce. That portion of the project has two components.

First, the game will be designed to create experiences that are effective at connecting with young women.

“We want women to understand and engage with the game and its educational content, in order to help change the existing trend that sees women turning away from computer science in middle school,” says **Kristy Boyer**, an associate professor of computer science at the University of Florida and co-PI on the project.

Second, the researchers will also be testing the game, and related curriculum, with 5,000 middle school students in North Carolina and Florida.

“These students are from diverse backgrounds, and attend schools in urban, suburban and rural areas,” Mott says. “We will be working to ensure that the game and related resources resonate with all students – not just advantaged ones.”

Development and testing of the game, as well as its related educational curriculum, is powered by a three-year, \$2.49 million grant from the National Science Foundation.

“Science classes are not solely about teaching students a bunch of facts, but about teaching young people how to think about science, engineering and problem solving,” says **Eric Wiebe**, a professor

## IMPACT BYTES



**DR. MUNINDAR SINGH** has been chosen as a recipient of the Alumni Association Distinguished Graduate Professorship Awards for 2016. He also recently won the 2016 International Foundation For Autonomous Agents in MultiAgent Systems (IFAAMAS) Influential Paper Award. The winning paper is titled, “Agent Communication Languages: Rethinking the Principles.” The paper appeared in IEEE Computer in December 1998 (vol. 31, no. 12), pp.40-47.



**DR. LAURIE WILLIAMS** professor of Computer Science, has been named Associate Department Head of the Computer Science Department. Williams was also recently selected as part of the inaugural class of the NC State Research Leadership Academy.



**DR. XIPENG SHEN**, associate professor of Computer Science, has been named an Association for Computing Machinery (ACM) Distinguished Speaker.



**DR. MLADEN VOUK**, head of the NC State Computer Science Department, was recently named Associate Vice Chancellor for Research Development, and was promoted to Distinguished Professor in Computer Science.

## Researchers Find Vulnerabilities in iPhone, iPad Operating System

An international team of computer science researchers has identified serious security vulnerabilities in the iOS – the operating system used in Apple’s iPhone and iPad devices. The vulnerabilities make a variety of attacks possible.

“There’s been a lot of research done on Android’s operating systems, so we wanted to take a closer look at Apple’s iOS,” says **William Enck**, an associate professor of computer science at North Carolina State University and co-author of a paper describing the work. “Our goal was to identify any potential problems before they became real-world problems.”



The researchers focused on the iOS’s “sandbox,” which serves as the interface between applications and the iOS. The iOS sandbox uses a set “profile” for every third-party app. This profile controls the information that the app has access to and governs which actions the app can execute.

To see whether the sandbox profile contained any vulnerabilities that could be exploited by third-party apps, the researchers first extracted the compiled binary code of the sandbox profile. They then decompiled the code, so that it could be read by humans. Next, they used the decompiled code to make a model of the profile, and ran series of automated tests in that model to identify potential vulnerabilities.



Ultimately, the researchers identified vulnerabilities that would allow them to launch different types of attacks via third-party apps. Those attacks include:

- Methods of bypassing the iOS’s privacy settings for contacts;
- Methods of learning a user’s location search history;
- Methods of inferring sensitive information (such as when photos were taken) by accessing metadata of system files;
- Methods of obtaining the user’s name and media library;
- Methods of consuming disk storage space that cannot be recovered by uninstalling the malicious app;
- Methods of preventing access to system resources, such as the address book; and
- Methods that allow apps to share information with each other without permission.

“We are already discussing these vulnerabilities with Apple,” Enck says. “They’re working on fixing the security

flaws, and on policing any apps that might try to take advantage of them.”

The paper, “SandScout: Automatic Detection of Flaws in iOS Sandbox Profiles,” will be presented at the ACM Conference on Computer and Communications Security, which is being held Oct. 24-28 in Vienna, Austria. Lead author of the paper is Luke Deshotels, a Ph.D. student at NC State. The paper’s co-authors include Mihai Chiroiu and Razvan Deaconescu of University Politehnica of Bucharest, and Lucas Davi and Ahmad-Reza Sadeghi of Technische Universität Darmstadt.

The research was done with support from the U.S. Army Research Office, under grant numbers W911NF-16-1-0299 and W011NF-14-1-0537; the National Science Foundation, under grant number CNS-1253345; the Seventh EU Framework Programme award number 609611; and the Deutsche Forschungsgemeinschaft award number CRC1119.



The NC State Institute for Advanced Analytics has appointed **DR. CHRISTOPHER HEALEY** to the Goodnight Distinguished Professorship in Advanced Analytics. Healey is a noted scholar in the field of data visualization and visual analytics.

Congratulations to **DR. TIFFANY BARNES** on winning the National Center for Women and Information Technology (NCWIT) Undergraduate Mentoring Award. Barnes was recognized for her outstanding mentorship, high-quality research opportunities, recruitment of women and minority students, and efforts to encourage and advance undergraduates in computing-related fields.



**MS. MARGARET HEIL** (\$20,000), **DR. MICHAEL KOWOLENKO** (\$30,000), **DR. TIMOTHY MENZIES** (\$40,000), **MR. KEN TATE** (\$40,000) and **DR. LAURIE WILLIAMS** (\$30,000) have been selected to receive highly competitive and selective 2016 IBM Faculty Awards. The awards recognize outstanding faculty achievement and are renewable each year.

**DRS. RUDRA DUTTA, XIPENG SHEN,** and **LAURIE WILLIAMS** have been elevated to Senior Member grade of the Institute of Electrical and Electronics Engineers (IEEE). They are members of an elite group in IEEE, as only 9% of the IEEE’s 433,000 members have achieved this level.

## 8 New Members Join Department's Strategic Advisory Board (SAB)

The NC State Computer Science Department is pleased to welcome eight new members to our Strategic Advisory Board (SAB), a cornerstone of the Department's strategic planning efforts. Dr. Mladen Vouk, head of the Department, recently announced the addition of the new members, including three alumni:

- **Joe Bastante**, Vice President of Enterprise Architecture at BCBS of NC
- **Gene Delsener**, Senior Vice President, Asset Management Support Services at Fidelity Investments
- **Matt Looney**, Director, Data Science & Enterprise Architecture at Eastman Chemical
- **Andy Rindos**, Program Director, Emerging Technology Institute at IBM
- **Linsey Rubenstein**, Vice President of IT Business & Supply Chain Systems at Boeing
- **Deborah Stokes\***, Senior Director of University Research at EMC
- **Kristopher Tyra\***, Director of Development at Deutsche Bank Global Technology
- **David Whitley\***, Senior Vice President, Product Development at Applied Systems

This dynamic group of industry executives and academic leaders provide input and guidance, which is critical to helping shape the department's strategic focus.

**Heather Miller**, VP of Global IT Strategy of InterContinental Hotels Group, is currently chair of the SAB, and **Mike Huska**, Director, Technical Architecture, Incentive Compensation COE of IMS Health, is the vice-chairman.

\* NC State Alumni

## Menzies Makes a PROMISE He Doesn't Plan to Keep, Not All to Himself Anyway

The slithery pitch of the snake oil salesman always rings true – if it sounds too good to be true, it probably is. Thanks to today's 24-hour accessibility to information, it can be rather hard to sell someone a "cure-all." In order to make sure something is legitimate today, the information has got to be online, easily accessible and current. Even before the advent of online information, great discoveries were made through the sharing of information, ideas, and research. Without information sharing, where would we be?

That is the question **Dr. Tim Menzies**, NC State professor of computer science, asked himself and a colleague almost a decade ago, when he realized that in software engineering, computer data mining was almost a rarity. In comparison to other professions that shared data openly, the professors discovered that of 154 sets of data found, only four percent of those sets were online as a resource to fellow computer scientists.

This premise of the different mentality of sharing data in software engineering led to the publication "On the Shoulder of Giants." Menzies, along with fellow professors **Dr. Earl Barr**, **Dr. Christian Bird**, **Dr. Eric Hyatt** and **Dr. Gregorio Robles**, discussed the longstanding hurdles facing data sharing in the industry – the fear of being scooped and the time and energy taken to record the data, in the hopes of discovering ways to lessen the risk of sharing in favor of the benefits to the field itself.

Menzies cited other sciences for their innovative ways to share, yet still garner credit for work well done. Astronomy, for example, allows the author to "own" one's own work for six months, but after that time period, you are required to share it with the public. Even a quick Google search of the professional body Science 2.0 shows 5,954,000 results from all sorts of disciplines.

"Even though there is great evidence of data sharing from other disciplines, it doesn't mean that everyone wants to play by the rules," he said. "The Hubble telescope actually caused a big problem by trying to hold onto its data longer than it was allowed."

Different theories abound as to why data mining is missing in computer science. Some blame the speed in which the discipline changes, rendering old data irrelevant before it is worthwhile to post. Others say that the more models shared, the more variances increase. Regardless of the mindsets, Menzies and his colleagues set out to change things with the creation of the PROMISE data repository that started as a grassroots effort 10 years ago and is growing by leaps and bounds today, thanks to support from NC State's computer science department and its upgrade to terabyte size.

Specializing in software engineering datasets, it offers free and long-term storage for research artifacts and membership in the valuable repository is by committee invitation. The "cost" of membership is the use of one graduate student who can devote time each month to the maintenance of the site.

"Sharing is a good thing," Menzies said. "We can't convince people to change their mentality of not sharing from the past, we've got to lead from the front. A case in point is our students that are working on PROMISE have been traveling all over the world and have been sharing their work on the repository which is raising interest in participation and changing minds about the need for sharing data."

Plans are for the site to continue to grow, as Menzies actively looks for corporate sponsors for an upgrade to a petabyte, so the information can continue to be accessible to the computer science community.

As a passionate advocate of sharing lessons learned, Menzies thinks the future of data storage for computer science is essential.

"It's not like when Newton was hit on the head that he just blurted out  $F = ma$ ," he said. "There is a continuing molding and revision of our ideas and if our community recognizes the efforts and we become more data centric, we have more evidence to back up our discussions and conclusions. It's like the philosophy of the snake oil salesman, with the data at our disposal, he can't sell us the snake oil anymore because now you can look it up and see what is in that snake oil before you buy it."

## Department Announces Masters Track in Software Engineering

The Department of Computer Science at NC State University is pleased to announce the approval and launch of a Masters Track in Software Engineering in the Computer Science Graduate Program curriculum. The curriculum is effective immediately.

“As software becomes increasingly important to our day-to-day lives, building and maintaining high quality software is critical,” says **Dr. Emerson Murphy-Hill**, Associate Professor of Computer Science. “The Masters Track in Software Engineering teaches students

the skills necessary to build and maintain such software systems.”

Curriculum requirements include both an overview of software engineering and a variety of more in-depth topics, including software security, testing and DevOps. The track has offerings both in the state-of-the-practice and state-of-the-art software engineering, with a special focus on evidence-based practice. Completion of the curriculum requires 31 credit hours including CSC 510 – Software Engineering (3), software science courses (9), software foundations courses (6),

computer science core courses, orientation course, and electives (13). Students must also complete three research projects and satisfy all the Master of Computer Science (MCS) requirements.

**Dr. George Rouskas**, Professor and Director of Graduate Programs, adds, “This concentration addresses an industry need for graduates with advanced software development skills. The Software Engineering Track reflects the Department’s strength in this field, both in terms of spectrum of course offerings and our faculty’s research activities.”

## New Tech Uses Hardware, Software to Train Dogs More Efficiently

NC State researchers have developed and used a customized suite of technologies that allows a computer to train a dog autonomously, with the computer effectively responding to the dog based on the dog’s body language.

“Our approach can be used to train dogs efficiently and effectively,” says **David Roberts**, an associate professor of computer science at NC State and co-author of a paper on the work. “We use sensors in custom dog harnesses to monitor a dog’s posture, and the computer reinforces the correct behavior quickly and with near-perfect consistency.”

“Because the technology integrates fundamental principles of animal learning into a computational system, we are confident it can be applied to a wide range of canine behaviors,” says **Alper Bozkurt**, an assistant professor of electrical and computer engineering and co-author of the paper. “For example, it could be used to more quickly train service dogs. Ultimately, we think the technology will be used in conjunction with human-directed training.”

The dog harness fits comfortably onto the dog and is equipped with a variety of technologies that can monitor the dog’s posture and body language. Each harness also incorporates a computer the size of a deck of cards that transmits the sensor data wirelessly. The researchers published a paper about the harness’s potential applications in late 2014.

For the current study, the researchers wrote an algorithm that triggered a beeping sound and the release of dog treats from a nearby dispenser whenever the dog’s harness sensors detected that the dog went from standing to sitting.

The researchers had to ensure that the reinforcement was given shortly after the desired posture was exhibited, and also ensure that rewards were only given for the correct posture. This required a trade-off. If the algorithm ran long enough to ensure the correct posture with 100 percent certainty, the reinforcement was given too late to be effective for training purposes. But if the reinforcement was given immediately, there was a high rate of rewarding the wrong posture.

To address this, the researchers worked with 16 volunteers and their dogs to optimize the algorithm, finding the best possible combination of speed and accuracy. The researchers then compared the algorithm’s timing and accuracy to that of an expert human trainer.

The algorithm was highly accurate, rewarding the appropriate behavior 96 percent of the time. But the human trainer was better – with a 100 percent accuracy rate.

However, while the average response time was about the same

for both algorithm and trainer, there was a lot of variation in the time of response from the trainer. The algorithm was incredibly consistent.

“That variation matters, because consistency is fundamentally important for all animal training,” Roberts says.

“In the long term, we’re interested in using this approach to animal-computer interaction to allow dogs to ‘use’ computers,” Roberts says. “For example, allowing an explosive detection dog to safely and clearly mark when it detects components of a bomb, or allowing diabetic alert dogs to use their physical posture and behaviors to call for help.”



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NC State Engineering Alumni



## Student Project Evolves into New Tool for the Biotech Industry

When **Scott Vu** started working on a computer science research project as a teenager, he didn't realize it would lead him down a path to earning a Ph.D. in biomedical engineering and launching a company designed to help the biotechnology industry operate more efficiently.

But Vu's story has been anything but typical. At the age of 4, he and his family were smuggled out of Vietnam on a boat. "Escaping," Vu says. At the age of 15, he enrolled at NC State as a full-time student, working toward a triple major in computer science, computer engineering and electrical engineering.

As an undergraduate, Vu began working with his mentor, **Donald Bitzer**, on a project aimed at creating a computer-based biophysical model to understand how to manipulate genes in bacteria to get those bacteria to produce specific proteins that they would not normally produce.

Vu's undergraduate project grew into a Ph.D. dissertation as Vu pursued a doctorate in the joint biomedical engineering program at NC State and UNC-Chapel Hill.

Incorporating techniques from computer science, biophysics, molecular biology and microbiology, Vu was ultimately able to not only fine-tune his model, but to use the model to "optimize" genes in bacteria so that they would produce many desired proteins quickly and accurately.

In late 2012, in the midst of his research on protein synthesis, Vu was inspired by a talk with **Mladen Vouk**, one of his Ph.D. committee advisers, to launch a venture and pursue a patent for the biophysical

model he had developed. Thus began the lengthy process of learning what he needed to know about the business world.

Vu began working with NC State's Office of Technology Transfer and took two courses that he credits with setting him on the right track. One was a class with **Steve Markham** in NC State's Poole College of Management, where he met fellow students **William Glauser** and **Joseph Thomas**, who would become co-founders of his company, RiboWiz Scientific. The other course was the "FastTrac" entrepreneurial training program with the Council for Entrepreneurial Development.

Ultimately, Vu created RiboScan™, a web-based tool based on the model he started developing as an undergraduate. A patent was submitted on Vu's technology before he completed his Ph.D., and he has already incorporated his company. The company, RiboWiz, is now seeking industry partners to commercialize the technology.

"We only incorporated RiboWiz in October, but we are already able to work with customers," Vu says. "We are looking forward to using our technology to help industry partners produce proteins they've been unable to make in the past. And we're also planning to file Small Business Innovation Research grant proposals, which would support future research to improve our model. We plan on expanding the model to predict and maximize protein production in eukaryotes and addressing issues related to protein aggregation caused by the misfolding of proteins during synthesis."