NC STATE Engineering

CSC NEWS

DEPARTMENT OF COMPUTER SCIENCE | FALL 2020

DEPARTMENT TAKES THE LEAD IN CYBERSECURITY EDUCATION 02

LETTER FROM THE DEPARTMENT HEAD GREGG ROTHERMEL

Dr. Gregg Rothermel

Dear alumni and friends of the Department of Computer Science:

Welcome to the Fall 2020 issue of the *CSC News* magazine. This has been a challenging year for everybody, especially our Wolfpack community. It has been a year in which every challenge has been met with new solutions. Even though the last six months have been nothing like we had planned or hoped for, I am proud of the way our faculty, staff and students have come together to move forward in the face of the COVID-19 pandemic. We have weathered this storm with great determination!

We are proud of the alumni, students, faculty and staff whose work and accomplishments are featured here. Once again, I'm happy to share with you that the department has been ranked first in the nation in the number of women tenured/tenure-track faculty members among departments of computer science in colleges of engineering by the American Society for Engineering Education. This has been the case for several years and is indicative of the commitment this department, our College of Engineering and NC State have made to building a diverse, inclusive academic community.

Here are some other recent highlights for the department, which you can read more about in these pages:

- Thanks to a $2.75M award from the National Science Foundation (NSF), the Department is pleased to announce the launch of **five annual CyberCorps® Scholarships for Service**, available to undergraduate and graduate students specializing in cybersecurity.
- Building on its success as a global leader in the artificial intelligence space, the Department announces the addition of an **endowed Goodnight Distinguished Professorship in Artificial Intelligence and Machine Learning**. The individual who accepts this new faculty position will be positioned as a key leader in the vibrant and expanding artificial intelligence community at NC State, the Research Triangle, and beyond.
- With over 15 years of experience on the front lines of cybersecurity efforts, **Dr. Thierry Wandji Ketchiozo has joined the department** as director of cybersecurity education. He will help train the next generation of computer scientists to protect critical systems from dangerous attacks.
- According to the 2020 Game Design School Rankings by the *Animation Career Review,* **NC State's Game Development Program** in the Department of Computer Science has been **ranked number one** in North Carolina and number seven in the South. Additionally, NC State was ranked among the top 25 percent of all schools nationally.
- **Dr. George Rouskas**, director of graduate programs and Alumni Distinguished Graduate Professor of Computer Science at NC State, received the **2019 Outstanding Service Award from the Optical Networking Committee** (ONTC) of the IEEE Communications Society at the 2019 IEEE GLOBECOM conference.
- **Dr. Munindar Singh**, alumni distinguished graduate professor of computer science at NC State, received the **2020 ACM / SIGAI Autonomous Agents Research Award**.
- **Dr. Arnav Jhala**, associate professor of computer science, has been recognized as a **senior member of the Association of Computing Machinery** (ACM).
- **Dr. Lina Battestilli**, teaching associate professor, has been named a **DELTA Faculty Fellow** for 2020-21.
- **Leslie Rand-Pickett**, director of graduate career services, was named the **Computer Science Department's** 2019-20 **Person of Exceptional Performance** (PEP) Award winner.
- Alumna **Marcia McLawhorn** (B.S. '70), has donated $12,000 as a lead gift to jumpstart efforts to **establish an endowment** to honor former department head and professor, **Dr. Alan L. Tharp**.
- Alumnus **Dr. Akond Rahman** (Ph.D. '19), an assistant professor in the Department of Computer Science at Tennessee Technological University, has received the **NC State College of Engineering's 2020 Distinguished Dissertation Award**.

In closing, let me thank you for your continued support of the Department. We're stronger when we support each other. We're stronger as a Pack!

Dr. Gregg Rothermel
Department Head

The Department of Computer Science is ramping up its research and education efforts in the area of cybersecurity to help meet a critical national need

In 30 years of teaching and research in the area of network and software security, Dr. Douglas Reeves has seen the landscape change drastically.

Hackers were once interested mostly in the notoriety, proving that they could break the most impenetrable systems, said Reeves, a professor in the Department of Computer Science (CSC). That changed in the mid-2000s, when organized crime saw the potential for profit and became very interested in cyberattacks.

"The motive for attacks has changed significantly over the last 20 years," Reeves, who is also the College's associate dean of graduate and international programs, said. "It's much higher stakes."

The CSC department is enhancing its research and education efforts with expanded offerings for undergraduate students, scholarship opportunities and a new cybersecurity research center.

The move will help meet a growing need for research that leads to more secure systems and for trained professionals to work in the industry. Cyber Seek, a website that provides data about supply and demand in the cybersecurity job market, reported that in North Carolina alone, 34,379 people are employed in the field and 19,657 job openings were listed between October 2018 and September 2019.

"The good news for students, of course, is that there are just unlimited opportunities," Reeves said.

FROM EDUCATION TO RESEARCH

The department launched a master's track in security in 2017 and an undergraduate track in 2019. At the same time, CSC has received a $2.75 million award from the National Science Foundation (NSF) to launch a CyberCorps® Scholarships for Service program that is available to undergrad and graduate students specializing in cybersecurity. Five scholarships will be awarded annually.

In addition to full tuition, the two-year scholarships provide a generous stipend, health insurance and an allowance for other professional expenses. In return, students agree to work after graduation with a federal, executive-branch government agency for an equal period of time. A newly created director of cybersecurity education position will oversee the undergraduate concentration and the scholarship program.

On the research side, the Secure Computing Institute (SCI) created in 2019 will pull together much of the work and funding already in place in CSC and other parts of the University. Chief among them is NC State's Science of Security Lablet, a National Security Agency program that has brought $19 million in research to NC State since it was established in 2012. Science of Security Lablets are multi-disciplinary labs at a handful of leading U.S. research institutions that promote security and privacy science as a recognized field of research and encourages rigorous research methodologies.

The institute and undergrad concentration will both include a strong industry component, enabling partner companies that work in cybersecurity or need more of it to benefit from research collaborations and have mutually beneficial interactions with students.

The department has eight faculty members in security and privacy, in areas ranging from cryptography to the security and privacy risks of sensors embedded in modern smart electronics, telephone networks and Internet of Things-enabled devices.

"We've worked very hard to create a really rounded-out security group that complements each other well," said Dr. William Enck, associate professor in the department and co-director of SCI.

THE BEST DEFENSE IS A GOOD OFFENSE

In order to teach students to be good defenders, Dr. Alexandros Kapravelos teaches them to be attackers.

As part of his undergraduate and graduate security classes, Kapravelos, an assistant professor of computer science, introduces his students to common cyber-attacks and has the students try them out in a test environment. It's the same idea behind HackPack, a student organization interested in cybersecurity that Kapravelos advises. Each spring, the group holds a Capture the Flag event that involves teams competing to solve security challenges.

"Fundamentally, in order to know what defense to play you need to know how the attackers play," Kapravelos said. "So, hopefully when they build software for a company, they will be more aware of the security problems that may be introduced."

Today's cybersecurity landscape includes thieves looking to empty your bank account, but also governments that want to gain access to other countries' infrastructure and companies trying to steal intellectual property from competitors.

Enck says that, despite all of the headlines about hacks that steal our data or threaten the U.S. energy grid, our systems are better prepared today than decades ago.

"Systems are more secure, but there are more attackers and they are better equipped. Both are true."

And we have more to lose. Kapravelos points out that when hacking was mostly done to prove a point, there wasn't much to gain. Today, our bank accounts and so much of our valuable personal data are online.

Most successful attacks, Dr. Laurie Williams, distinguished professor of Computer Science, says, fall under what she calls social engineering, relying on a human mistake instead of a hole in a system. An email disguised as a message from a friend tricks you into sharing important information. Someone claiming to be an IT technician for your company hands you a USB drive that you plug into your computer.

Security risks are everywhere, from airplanes to self-driving cars. That's why, instead of offering a degree program that would focus solely on cybersecurity (the route that some universities have chosen), NC State CSC's intention is to give students a broad knowledge base that includes security concepts for whatever platform they are working on, said Williams, who is also a co-director of SCI.

"We're trying to create computer scientists who are also experts in security," she said. "You need that domain expertise, plus security." ■

New director of cybersecurity education joins Department of Computer Science

"I want to be able to make NC State the household name when it comes to cyber education within the state, outside of the state and outside of the United States"

Dr. Thierry Wandji Ketchiozo

Dr. Thierry Wandji Ketchiozo

Dr. Thierry Wandji Ketchiozo has spent 15 years on the front lines of cybersecurity efforts, working as an engineer for the Department of Defense fighting attacks that are growing more and more sophisticated and posing a dire threat to the nation's security.

Now, Ketchiozo has joined NC State as the director of cybersecurity education in the Department of Computer Science to help train the next generation of engineers and computer scientists who will continue his work protecting critical systems from dangerous attacks.

The newly created position is a critical piece of CSC's effort to increase its role as a national leader in cybersecurity education and research. It is a key part of the Security Computing Institute (SCI), founded at NC State in 2019 with a goal of enhancing the security and privacy of computing systems through basic and applied research and advancing and delivering cybersecurity education.

"I want to be able to make NC State the household name when it comes to cyber education within the state, outside of the state and outside of the United States," Ketchiozo said.

Ketchiozo, who started with NC State on August 24, holds a bachelor's degree from University of Montreal, master's degrees from Morgan State University and University of Maryland University College (UMUC) and a Ph.D. from George Washington University. After jobs in private industry, he held senior positions as a researcher and software and systems engineer for the U.S. Naval Research Laboratory and Naval Air Systems Command.

At the same time, he has held teaching positions in the area of cybersecurity at Morgan State and UMUC. Ketchiozo said that he sees an urgent need for increased cybersecurity expertise in the United States and saw the new position at NC State as a chance to pass on what he has learned in industry, academia and public sector work both to students and to professionals who need more expertise.

Along with that need comes opportunity for those with experience in the field. At the Department of Defense, Ketchiozo said, it's difficult to recruit engineers with the broad expertise to fend off constant cyberattacks. It's a common story across the country: The Cyberseek organization, part of the National Institute of Standards and Technology, currently indicates a half-million unfilled cybersecurity positions in the United States.

Companies and government entities are under a constant barrage of attacks that can cost billions of dollars annually. And the recent COVID-19 outbreak in the United States has only exacerbated that problem, Ketchiozo said, with so many professionals working from home and relying even more on technology, often using personal tech that isn't secure.

Ketchiozo's position is broad and will include supporting new degree programs in CSC and a new cybersecurity scholarship program and working to apply for additional grant funding and furthering K-12 outreach efforts including summer camps.

The last task is particularly important, Ketchiozo said, if the United States wants to create a new generation of cybersecurity experts who can keep the nation safe. We'll need more domestic students pursuing advanced degrees in the field, and that's a task that can't wait until students are college-age; outreach that helps promising students decide to pursue cybersecurity work must begin while they are still in grade school.

"You have to start early," he said. "You need to have a comprehensive plan."

A CYBERSECURITY LEADER

CSC in recent years has worked to build off a strong foundation in cybersecurity education and research and become a global leader.

That begins with SCI, which pulls together much of the work and funding already in place in CSC and other parts of the University. Chief among them is NC State's Science of Security Lablet, a National Security Agency program that has brought $19 million in research to NC State since it was established in 2012. Science of Security Lablets are multi-disciplinary labs at a handful of leading U.S. research institutions that promote security and privacy science as a recognized field of research and encourages rigorous research methodologies.

Co-led by Dr. Laurie Williams, Distinguished Professor, and Dr. William Enck, associate professor, in CSC, the SCI includes seven computer science faculty members and two faculty members in the Department of Electrical and Computer Engineering and has established collaborations with NC State faculty members in the College of Management and Department of Psychology.

CSC established a master's track in security in 2017 and an undergraduate track in 2019. A new undergraduate concentration will start in spring 2021 and the department plans to soon propose to University officials a master's degree in cybersecurity.

In 2019, the department received a $2.75 million award from the National Science Foundation to launch a CyberCorps® Scholarships for Service program. Five scholarships will be awarded annually to graduate and undergraduate students specializing in cybersecurity.

In addition to full tuition, the two-year scholarships provide a generous stipend, health insurance and an allowance for other professional expenses. In return, students agree to work after graduation with a federal, executive-branch government agency for an equal period of time.

Williams' said the vision for SCI is to create a hub that is recognized across the state as the epicenter for cybersecurity education in North Carolina. Part of that vision is to offer resources for companies that want to train or retrain their employees on security, something that the department isn't offering currently. Establishing those resources will require building partnerships across the state, which Williams sees as an important part of the new position.

She said that Ketchiozo stood out as the right fit for the new position because of his very strong technical background, and the fact that he has helped establish similar programs at Morgan State and UMUC.

To help further that effort, future plans include creation of a director of cybersecurity practice position.

The payoff, for the state and nation and for NC State students seeking good career opportunities and work that makes a difference, is huge.

"There's a huge national shortage and a huge North Carolina shortage of highly trained cybersecurity professionals," Williams said. ▪

Celebrating the Spring 2020 academic success

The 2019-20 academic year is one that will go down in history. In early March, our students thought they were leaving for just another spring break. But spring break was extended, and at the end of the break, they learned that life as they knew it as an NC State student would never be the same. Everything — classes, group meetings, interviews — everything went virtual. No one was allowed on campus. All because of COVID-19. But our students persevered. They adapted to the new normal and they continued to succeed.

A lot has changed this year, but the one thing that has not changed is the caliber of our students and the outstanding accomplishments of this group. On May 7, the Computer Science Department held a virtual Spring 2020 Celebration of Academic Success to recognize our 2019-20 students and celebrate the many fellowships, honors and awards they had won.

During our video celebration, six Ph.D. candidates, 165 master's degrees students and 166 candidates for the bachelor's degree in computer science were recognized. Dozens more were recognized for receiving best paper awards at prestigious conferences, College of Engineering merit awards, fellowships, leadership awards, outstanding senior awards and more.

The Computer Science Department is pleased to celebrate the many accomplishments of our students this year, and we are particularly proud of the way that they have adapted, adjusted and flourished under these extreme circumstances. Please take time to view the video of our Spring 2020 Celebration of Academic Success (**bit.ly/2Zzh1a1**), and join us in applauding the success of our Spring 2020 graduates. ▪

$2.75 million NSF award helps launch new CyberCorps® scholarships for service

Thanks to a $2.75 million award from the National Science Foundation (NSF), the department is pleased to announce the launch of five annual CyberCorps® Scholarships for Service, available to undergrad and grad students specializing in cybersecurity.

To be considered, students must be U.S. citizens or permanent residents, and majoring in computer science at the bachelor's or master's level with a specialization in cybersecurity.

In addition to full tuition, these two-year scholarships provide a generous stipend, health insurance, and an allowance for other professional expenses. In return, the student agrees to work after graduation with a federal, executive-branch government agency for an equal period of time. The program includes mentoring, professional opportunities while in school, and assistance finding internships and post-graduation full-time employment in government.

Co-PIs for the award, Drs. Douglas Reeves and Sarah Heckman, were on hand in Washington, D.C. in mid-January to be recognized as one of the recipients of the prestigious awards. The current award will cover five students per year and will run through 2024.

Reeves, associate dean and professor of computer science, says the NSF's selection of NC State to participate in the CyberCorps® Scholarships for Service program speaks to the significant focus the department has put on building its expertise in cybersecurity education and research.

"At NC State, we are charged with educating the next generation of cybersecurity professionals, a critical need for the state of North Carolina and the nation as a whole," says Reeves. "We now have security tracks available for undergrads and M.S. students, and we have hired a director of cybersecurity education, who will help us launch a new cybersecurity concentration, formulate a strong community of practice, engage with industry and government partners and attract, develop and nurture a strong pipeline of security-focused talent," says Reeves. "The availability of these transformative scholarships really speaks to the momentum we are gaining in the cybersecurity space."

Heckman, director of undergraduate programs, says the new CyberCorps® Scholarships are both substantive and transformative in nature. "They are among the most robust and valuable scholarships currently available at NC State and a great opportunity for those interested in cybersecurity," Heckman says.

For more information, see **go.ncsu.edu/sfs** ▪

Improving AI's ability to identify students who need help

A team of researchers from NC State has designed an artificial intelligence (AI) model that is better able to predict how much students are learning in educational games. The improved model makes use of an AI training concept called multi-task learning, and could be used to improve both instruction and learning outcomes.

Multi-task learning is an approach in which one model is asked to perform multiple tasks.

"In our case, we wanted the model to be able to predict whether a student would answer each question on a test correctly, based on the student's behavior while playing an educational game called Crystal Island," says Dr. Jonathan Rowe, co-author of a paper on the work and a research scientist in NC State's Center for Educational Informatics (CEI).

"The standard approach for solving this problem looks only at overall test score, viewing the test as one task," Rowe says. "In the context of our multi-task learning framework, the model has 17 tasks — because the test has 17 questions."

> "[The model] opens the door to incorporating more complex modeling techniques into educational software — particularly educational software that adapts to the needs of the student,"
>
> **Andrew Emerson**

The researchers had gameplay and testing data from 181 students. The AI could look at each student's gameplay and at how each student answered Question 1 on the test. By identifying common behaviors of students who answered Question 1 correctly, and common behaviors of students who got Question 1 wrong, the AI could determine how a new student would answer Question 1.

This function is performed for every question at the same time; the gameplay being reviewed for a given student is the same, but the AI looks at that behavior in the context of Question 2, Question 3, and so on.

And this multi-task approach made a difference. The researchers found that the multi-task model was about 10 percent more accurate than other models that relied on conventional AI training methods.

"We envision this type of model being used in a couple of ways that can benefit students," says Dr. Michael Geden, first author of the paper and a postdoctoral researcher at NC State. "It could be used to notify teachers when a student's gameplay suggests the student may need additional instruction. It could also be used to facilitate adaptive gameplay features in the game itself. For example, altering a storyline in order to revisit the concepts that a student is struggling with."

"Psychology has long recognized that different questions have different values," Geden says. "Our work here takes an interdisciplinary approach that marries this aspect of psychology with deep learning and machine learning approaches to AI."

"This also opens the door to incorporating more complex modeling techniques into educational software — particularly educational software that adapts to the needs of the student," says Andrew Emerson, co-author of the paper and a Ph.D. student at NC State.

The paper was also co-authored by Dr. James Lester, distinguished university professor of Computer Science and director of CEI; and by Roger Azevedo of the University of Central Florida.

The work was done with support from the National Science Foundation and the Social Sciences and Humanities Research Council of Canada. ▪

Big data for better sweetpotatoes: An interdisciplinary project increases the value of sweetpotatoes

When it comes to growing sweetpotatoes, North Carolina is a superstar — growing more than the next three states combined.

An interdisciplinary team of researchers at NC State is setting out on an ambitious three-year project that will use artificial intelligence to make sweetpotatoes even more profitable.

The team will work with sweetpotato producers and NC State College of Agriculture and Life Sciences research stations to image hundreds of thousands of sweetpotatoes and then calculate their shape and quality characteristics.

Led by Dr. Cranos Williams, a researcher in NC State's Department of Electrical and Computer Engineering (ECE), the team will then combine all of that image data with a host of additional information. When and where were the sweetpotatoes planted? How were they fertilized? What has the weather been like? The researchers can then use advanced machine learning algorithms to determine which factors impact sweetpotato size and shape. Ultimately, the goal is to increase the percentage of sweetpotatoes that are USDA grade 1, and thus most profitable for growers.

"Our first step starts with the stakeholders, where we are focused on understanding their values and identifying the things that would improve their profitability," Williams said. "By understanding what our stakeholders value, we can provide input on how growers, producers and distributors can optimize their processes to potentially reduce the occurrence of misshaped sweetpotatoes. This will translate to decreased waste and increased value."

Dr. Khara Grieger, a senior researcher in the Genetic Engineering and Society Center, is an expert in the intersection of science and society, particularly concerning emerging technologies. She will lead efforts engaging with stakeholders in conjunction with Dr. Anders Huseth, a researcher and extension specialist in the Department of Entomology and Plant Pathology.

The team, including Dr. Mike Boyette, a Philip Morris professor of Biological and Agricultural Engineering, has identified quite a number of different factors that might impact sweetpotato shape and size and overall value, but they need to leverage the power of big data and machine learning to be able to sort the metaphorical wheat from the chaff.

The project is one of four interdisciplinary projects selected by NC State's Office of Research and Innovation to receive seed funding to address the global challenges facing agriculture identified by the North Carolina Plant Sciences Initiative (NC PSI).

MEASURING SWEETPOTATOES

Boyette has spent decades improving the value of the North Carolina sweetpotato industry including work on controlled storage facilities, value-add products and measuring the shape and size of sweetpotatoes.

Boyette has identified quite a number of different factors that might impact sweetpotato shape. These factors include precipitation levels at key stages of growth, the type of fertilizer used and when it is applied, the variety of sweetpotato planted, and soil type.

"We know from anecdotal evidence that all these things and more have an effect on the shape of the sweetpotato," Boyette said. "You get all of these factors going together but how do you sort these things out? How do you know what you need to do to maximize the value of the sweetpotato? The only way is to

measure the sweetpotatoes coming out of the field."

Boyette, and his summer interns and graduate students, have been working on this for 20 years, starting with calipers, then moving onto a laser scanner. "It was tedious and time consuming to measure enough sweetpotatoes for statistical analyses," he said.

"Technology has progressed to the point that state-of-the-art packers use an optical scanner to sort their sweetpotatoes. These sorters can scan 100,000 sweetpotatoes in an hour, producing eight to 10 gigabytes of data per minute," Boyette added.

Now, the challenge is collecting all of that data, which is normally discarded, and analyzing it. This is where Williams and other big data, data analytics and data privacy experts come in. This team includes Dr. Natalie Nelson, a researcher in the Department of Biological and Agricultural Engineering (BAE); Dr. Edgar Lobaton, a researcher in ECE; and Drs. Kemafor Ogan, and Alessandra Scafuro, researchers in CSC.

"We're very lucky to be able to put together the team we have put together," Boyette said. "We've got people who are really good at the sensors and scanning. We've got people who are really good at big data management and analysis. And ultimately we'll all work together to improve the value of North Carolina sweetpotatoes."

CHALLENGE OF BIG DATA

Williams agrees that collecting, managing and analyzing all of the data produced by the current state-of-the-art sorters is a big challenge.

And that doesn't even take into account the amount of data that will be produced by a new system that will also be capable of measuring internal pest damage and rot that will be developed by a team led by Dr. Mike Kudenov, another researcher in ECE, as part of the project.

"One of the biggest challenges we foresee, and something that we've been trying to mitigate early, is managing all of the data," Williams said. "These sorters produce a large amount of data and we have to identify, not only ways of being able to collect it but also effectively store it and manage it. On top of that we will need to collect and manage extrinsic data such as planting and harvesting dates and fertilization information."

The team is partnering with two companies to assist with this challenge, SAS Institute and Intero Life Sciences. SAS Institute is an analytical software company based in Cary, NC, with a longstanding partnership with NC State. SAS Institute has many data analysis and data modeling tools as well as considerable

experience in data analytics. Intero Life Sciences, a Chapel Hill-based bioinformatics company, is experienced in developing platforms for managing large sets of heterogeneous data, similar to what the project will produce, Williams said.

"We're looking forward to working with them and gaining their input, in terms of informing the best way to build the type of platform we'll need for the project," Williams said. "And in return, our industry partners will have an opportunity to assess how their solutions can be applied to problems that directly relate to agricultural stakeholders. Oftentimes, these industry partners have the experience and the tools but they lack the relationships that NC State has been able to develop with stakeholders."

In addition, the team is partnering with Scott Farms, a sixth-generation family farm in Wilson County that grows more than 3,000 acres of sweetpotatoes, and the NC Sweetpotato Commission.

The partnership with Scott Farms will help the team develop decision-support platforms and establish the proof-of-concept to show the impact of the platform for NC sweetpotato growers. The partnership with the NC Sweetpotato Commission provides an effective way of communicating the value of such a platform to increase the production of USDA grade 1 sweetpotatoes to the industry as a whole.

Another aspect of the project is to provide students with hands-on training on tackling agricultural challenges with big data. Dr. Daniela Jones, a researcher in BAE who heads the agriculture data science certificate program, will lead this aspect. Three undergraduate students worked remotely on the project this summer.

"A significant part of our workforce training effort is to expose new students to companies such as SAS as well as enable opportunities on further integrating sensor development and data analytics into agricultural problems," Williams said. "It was important to us to make sure that we can use this GRIP4PSI project as a mechanism for training the next generation of researchers to be able to tackle problems like this, or even more complex ones."

The interdisciplinary project is funded by the GRIP4PSI seed-funding program, based on NC State Office of Research and Innovation's 2016 Game-Changing Research Incentive Program (GRIP). The new program is led by the Office of Research and Innovation in partnership with eight NC State colleges and offices. GRIP4PSI is intended to support visionary ideas in the plant sciences that will result in large-scale funding, meaningful impact for future research and first-class interdisciplinary graduate education and training. ■

Game development program ranked first in North Carolina

From top: Dr. David Roberts, and Dr. Arnav Jhala

According to the 2020 Game Design School Rankings by the Animation Career Review, NC State's Game Development Program in the Department of Computer Science has been ranked number one in North Carolina and number seven in the South. Additionally, NC State was ranked among the top 25 percent of all schools nationally.

After considering more than 130 different schools with game design programs across the United States, the Animation Career Review ranked programs through surveys and gathering information based on criteria including academic reputation, admission selectivity, depth and breadth of the program, value as it relates to tuition and indebtedness, and geographic location.

The department began offering a concentration in Video Game Development in 2008. Since then, the program has developed into one of the best in the nation. While students focus on the development of video games and software engineering processes, the program also allows students to take non-computer science electives, which will aid in their holistic development as well-rounded students with multifaceted skill sets.

Dr. David Roberts, associate professor of computer science and the concentration's director, commented on the many benefits of the interdisciplinary program.

"I think it's critically important that students are well rounded. Computer science as a discipline has expanded over the last 20 years to touch virtually every sector of the economy in some way… The opportunity for our students to get training in the deeply technical elements of video game development, but also exposure and training in the visual, psychological and narratological aspects of game design creates well-rounded work-force participants."

> "I think one of our strengths is that we are one of the big research universities in the field. The access to cutting-edge research allows us to look ahead to the problems that the industry will be facing and makes us unique … We want to make sure students have all the opportunities to be successful.,"
>
> **Dr. Arnav Jhala**

Dr. Arnav Jhala, associate professor of computer science, commended the resources and opportunities offered to students by NC State.

"I think one of our strengths is that we are one of the big research universities in the field. The access to cutting-edge research allows us to look ahead to the problems that the industry will be facing and makes us unique …We want to make sure students have all the opportunities to be successful."

Students in the Video Game Development Concentration at NC State can successfully advance in the field of computer science while gaining a multi-disciplinary view of game development. ∎

Browser tool aims to help researchers ID malicious websites, code

Researchers in the department have developed an open-source tool that allows users to track and record the behavior of JavaScript programs without alerting the websites that run those programs. The tool, called VisibleV8, runs in the Chrome browser and is designed to detect malicious programs that are capable of evading existing malware detection systems.

"When you go to most websites, your browser starts running the site's JavaScript programs pretty much immediately — and you have little or no idea of what that JavaScript is doing," says Dr. Alexandros Kapravelos, co-author of a paper on VisibleV8 and an assistant professor of computer science at NC State. "Previous state-of-the-art malware detection systems rely on making changes to JavaScript code in order to see how the code is being executed. But this approach is easily detected, allowing malware programs to alter their behavior in order to avoid being identified as malicious.

"VisibleV8 runs in the browser itself, recording how JavaScript is executed; it doesn't interact with the code and, as a result, is far more difficult to detect."

VisibleV8 saves all of the data on how a site is using JavaScript, creating a "behavior profile" for the site. That profile, and all of the supporting data, can then be used by researchers to identify both malicious websites and the various ways that JavaScript is used to compromise web browsers and user information.

Because VisibleV8 consists of only 600 lines of code, out of the millions of lines of code in Chrome, the software tool is relatively easy to keep up-to-date. This is an important consideration given that Chrome's code is updated approximately every six weeks. VisibleV8 can also be used to target the most likely malicious behaviors without hurting browser performance.

"We've created a stealthy tool for monitoring JavaScript in the wild," Kapravelos says. "We're now making it open source, in hopes that it will be useful to anyone doing research on web privacy and security."

The paper, "VisibleV8: In-browser Monitoring of JavaScript in the Wild," was presented at the ACM Internet Measurement Conference 2019 in Amsterdam, Netherlands. First author of the paper is Jordan Jueckstock, a Ph.D. student at NC State.

The work was done with support from the Office of Naval Research, DARPA and the National Science Foundation.

VisibleV8 can be downloaded from Kapravelos' site at **kapravelos.com/projects/vv8**. ∎

Making (fun) multi-player gaming an educational experience
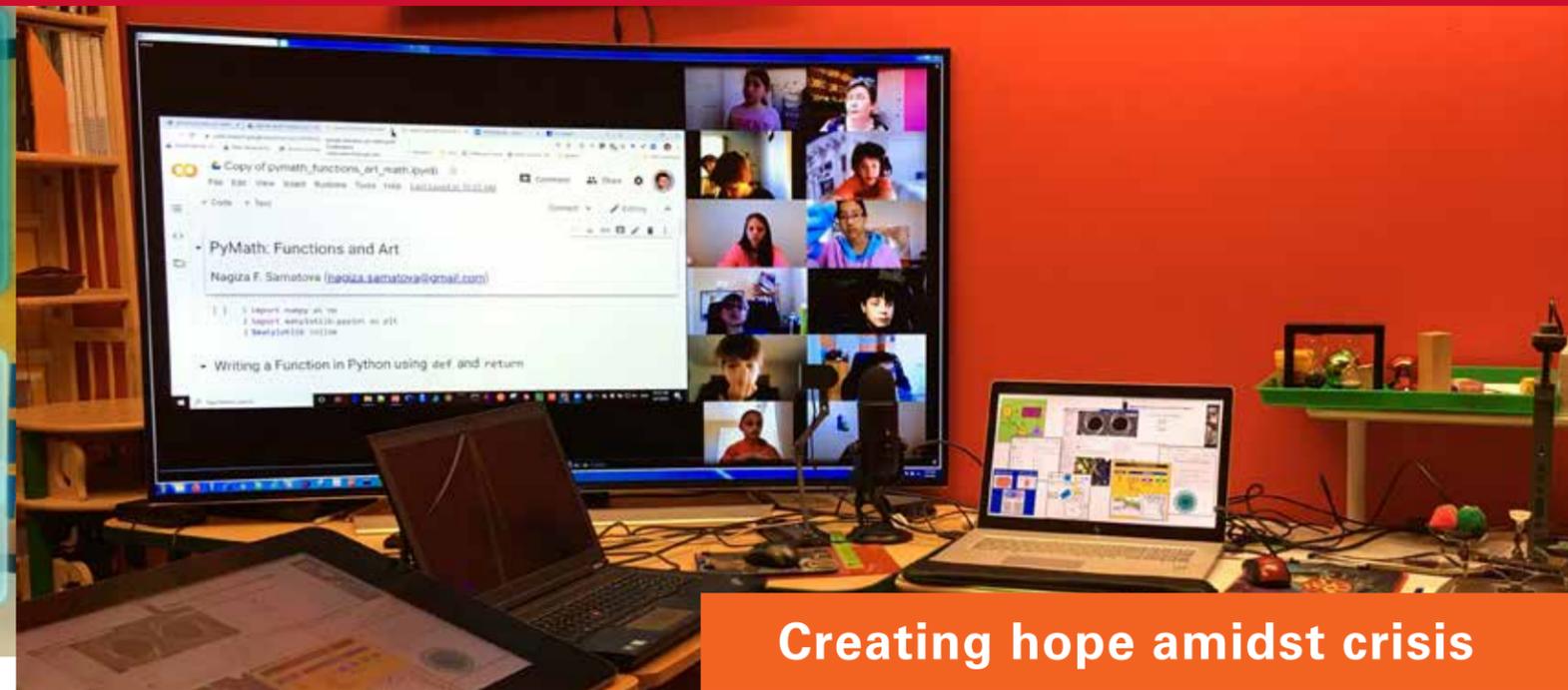
A new video game framework brings together two well-studied approaches to educational software in order to keep multiple players engrossed in the learning experience while fostering collaboration and problem solving. The framework is one of the first to integrate narrative-centered learning and collaborative learning techniques, laying the groundwork for future efforts in the field.

In proof-of-concept testing, a team of researchers from NC State and Indiana University found a game made using the framework fostered both learning and effective collaboration in sixth graders.

"There's been a lot of work on computer-supported collaborative learning," says Dr. Jonathan Rowe, co-author of a paper on the work and a research scientist in NC State's Center for Educational Informatics (CEI). "But that work hasn't focused on rich, narrative game environments — it's been more along the lines of online discussion forums for students."

"Meanwhile, there's also been a lot of work on narrative-centered learning environments," Rowe says. "But those have focused largely on single-player settings — because constructing immersive games that are educational and engaging for multiple players is extremely challenging."

"We've developed a conceptual framework for combining these two educational approaches — interactive narratives and collaborative, problem-based learning — and then created a software architecture and suite of game-creation tools for implementing that framework," says Dr. Bradford Mott, first author of the paper and senior research scientist at CEI.

The paper, "Designing and Developing Interactive Narratives for Collaborative Problem-Based Learning," was presented at the Twelfth International Conference on Interactive Digital Storytelling, held at the Snowbird resort last November.

"One of the things we focused on here was creating a set of tools that educators can use, regardless of their programming skills," says Robert Taylor, a research software engineer at CEI. "Specifically, allowing educators to modify a story's dialogue and plotlines, and to see those changes almost immediately in the game."

"Right now, this narrative editing feature is being used by our education research collaborators to help us make the best game possible," Mott says. "But at some point, this may be a feature that can allow for classroom-specific game customization."

The team of education and computer science researchers has already used the framework to develop a game called "Crystal Island: EcoJourneys," which focuses on ecosystems education. In pilot testing with a group of 45 middle schoolers, the researchers found students did learn from the game and exhibited effective collaboration skills.

"We deliberately chose a complex subject, because that makes for a scenario that lends itself to team-oriented problem solving," Rowe says. "This early-stage testing suggests that we're on the right track."

"We're now developing a more polished version of 'Crystal Island: EcoJourneys,' which we'll be testing on a larger scale next year," Mott says. "More importantly, the approach we're outlining here can already be used by others in the educational gaming community. This is an exciting area for the field."

The paper was co-authored by Dr. Seung Lee, a research scientist at CEI; Dr. James Lester, Distinguished University Professor of Computer Science and director of CEI at NC State; and Drs. Asmalina Saleh, Krista Glazewski, and Cindy Hmelo-Silver of Indiana University.

The work was done with support from the National Science Foundation. ▪

Creating hope amidst crisis

Dr. Nagiza Samatova, a professor in the department, has been using her time to create hope and provide resources amidst the COVID-19 crisis. Specifically, she has been providing online, STEM-focused training for students of all ages free of charge.

With schools in the Triangle area being forced to transition to online teaching on such short notice, Samatova quickly recognized the need for some additional help for students in her local community. "Teaching for the first time is a bit challenging. It's difficult for parents who have never thought about homeschooling their children to be forced to become homeschool parents." Additionally, the situation has raised other issues including that many of these parents also work and may not have time to help their children with their studies or do not have the financial means to afford online courses.

After reading about these struggles that were shared by those in Facebook groups of local communities she is a part of, Samatova decided to offer her help, "I knew I could not go to the hospital and help there, but I knew I had my tool, and that tool is teaching."

Since then, Samatova has developed online classes for students to join via Zoom. These classes focus on a variety of STEM subjects such as Math Kangaroo and Math Olympiad for elementary and middle school students, and classes focusing on more advanced topics such as Artificial Intelligence and Machine Learning with Python for older students and their parents.

However, these classes are not typical lectures. By using a variety of teaching methods, Samatova has successfully created interactive, engaging, and hands-on classes. Samatova uses camera technology to provide her students with visual demonstrations so that they may better understand the material. For these demonstrations, Samatova uses common, household objects so that students may follow along using their own materials, creating a hands-on experience. Additionally, she uses the break-out room feature on Zoom to allow her students to brainstorm, communicate, and creatively solve problems together. This allows students to stay engaged in class and connect with fellow classmates.

Samatova specially curates each class to ensure that her students are properly learning and retaining the information that is taught. She does this by providing additional resources such as homework assignments and practice problems for students to do outside of class. Another way she ensures the success of her students is by engaging with the parents as well. After four weeks of classes, Samatova meets with the parents of the students to discuss how the students are doing, what questions parents may have, and what improvements could be implemented.

Samatova is actively giving back to her community by offering these classes. Her classes are an excellent example of the importance of building the bridge between local schools and the university. While teaching may be a bit difficult at first, Samatova believes that anyone can teach and urges others to get involved to help their community.

Navigating life during COVID-19 is hard. Yet, stories like this surely give us something to smile about and inspire us to give back to our own communities as well. To date, Samatova's online classes have touched the lives of K-12 students and their parents "sheltering in place" across the Triangle Area and beyond. ▪

Study debunks robocall myths, lays groundwork for stopping them

of calls essentially makes it impossible for the person who actually has the relevant phone number to use their phone. However, because robocallers switch numbers fairly often, the inconvenience usually only lasts for a day or two."

But while those findings are interesting, some of the most important findings stem from the researchers' analysis of the robocall's audio recordings.

"First of all, about 62 percent of the unsolicited calls our numbers received included practically no audio at all — which was surprisingly high," Prasad says. "And only a little more than half of the remaining 38 percent contained enough audio data to allow for us to conduct a robust assessment."

"But what was exciting was that we were able to identify calls that were identical or nearly identical, allowing us to group calls into clusters that were clearly all affiliated with a single campaign," Reaves says.

"This is a big deal because tracing a call back through communication service providers is a manual process that takes time," Reaves explains. "We started with answering just over 146,000 calls — it would be impossible to trace them all back. But first we eliminated all the silent calls, that narrows it down considerably. Then we were able to cluster calls together into 2,687 specific campaigns. Most of the campaigns only made a few calls, but a handful of those campaigns made thousands of calls. So, effectively you can narrow down a big chunk of robocalls to only a few campaigns. And you can track those down. That's a subject we'll be discussing at greater length in the future."

The paper, "Who's Calling? Characterizing Robocalls through Audio and Metadata Analysis," was presented Aug. 12 at USENIX Security Symposium, where it received the first place Internet Defense Prize from Facebook and a Distinguished Paper award. The paper was co-authored by Elijah Bouma-Sims, an undergraduate at NC State, and by Athishay Kiran Mylappan, a former graduate student at NC State. The work was done with support from the National Science Foundation. ▪

New research in the department finds that the number of robocalls isn't going up, and that answering a robocall doesn't make you more likely to get additional robocalls. However, stories you've heard about individuals getting hundreds of back-to-back unsolicited calls? Those are true.

"These findings stem from a broader study that is the first step toward a more robust set of tools for reducing robocalls, if not eliminating them," says Dr. Brad Reaves, co-author of a paper on the work and an assistant professor of computer science. "We made some fundamental advances in tracking robocalls back to their source, and upended a lot of the conventional wisdom regarding robocalls."

"The COVID-19 pandemic has really highlighted the importance of this work, because robocalls have made people less likely to answer phone calls from unknown numbers – and that makes it more difficult for contact tracers to do their jobs," says Sathvik Prasad, a Ph.D. student at NC State and first author of the paper.

For this work, the researchers define robocalls as automated or semi-automated calls that play a recorded message. To address questions related to robocalls, the researchers worked with communications company Bandwidth Inc. to set up 66,606 phone lines that would be used exclusively to monitor for robocalls. The ultimate goal was to collect data on how robocalls and robocall campaigns worked. The researchers monitored the lines for eleven months, from early 2019 to early 2020.

To provide some sense of scale, the relevant phone lines received 1,481,201 unsolicited calls over the 11-month study

period. The researchers used an automated system to answer more than 146,000 of those calls. The system also recorded the calls and analyzed the audio.

"One of our research questions was whether robocalls were getting worse, or becoming more frequent," Prasad says. "We found that the answer is no — the number of robocalls was virtually identical from month to month."

"We were also curious about whether answering a robocall made it more likely that a phone line would receive additional robocalls," Reaves said. "For years, messaging from government agencies and trusted nonprofit organizations has focused on reducing robocalls by not answering calls from unknown numbers. And while we encourage people to avoid engaging with robocalls, we found that answering a robocall has no effect on the number of robocalls you receive."

The researchers did, however, find that another widespread story about robocalls was true.

"Everyone on the research team had heard stories about a friend of a friend of a friend who had gotten so many unsolicited calls that they couldn't even use their phone for a day or two," Reaves says. "And we found that this is a rare, but real, phenomenon. We dubbed these high call-volume events 'storms,' and found that they happen when a robocaller identifies itself using a fake phone number — and that phone number actually belongs to someone else. If the robocaller makes hundreds of thousands of calls using the fake number, hundreds of people see it on their 'missed calls' list and call it back. The high volume

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Five new members named to Strategic Advisory Board

The department is pleased to welcome five new members to the Computer Science Strategic Advisory Board (SAB):

- **Jim Fletcher***: strategy partner at Momenta Partners
- **Bryan Harris:** senior vice president of research and development at SAS
- **Peggy Pranschke:** senior director, Data Science and Advance Artificial Intelligence at Advance Auto Parts
- **Mark Risoldi:** executive director, global head of information risk management at Merck
- **Felix Ritscher-Montilla:** director of cybersecurity operations and engineering at PRA Health Sciences

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

Dr. Gregg Rothermel, professor and department head, expressed his gratitude to the new additions. "Our SAB performs a tremendous service to the department, providing industry-specific guidance and direction that helps us ensure our strategic plans are well aligned with the industry needs, and assuring that we continue to do our part to supply talent and research that fuels the economy of North Carolina and beyond. These new additions to the board bring tremendous experience and wisdom that will benefit us greatly in the future."

The SAB is currently chaired by Tracy Doaks, who was recently appointed Secretary of the NC Department of Information Technology. Kim Calhoun, founder and CEO of Guartanator and senior executive producer of MoneyMasters. TV, is the current vice-chairperson. ▪

*NC State Alumni
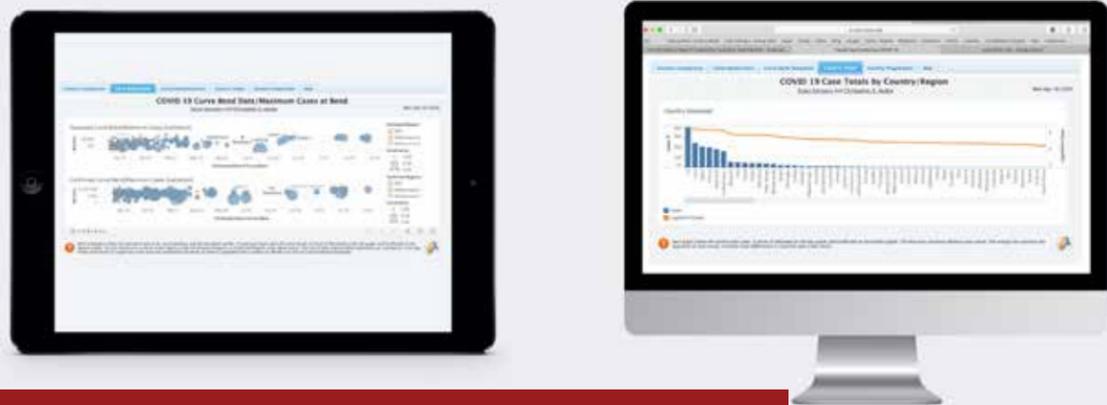
Visualization tool tracks COVID-19

"How does where I live compare with other regions in reports of COVID-19 infections and deaths? When should we expect our region to start 'flattening its curve,' or showing declines in the number of COVID-19 cases?"

NC State analytics experts Drs. Christopher Healey and Susan Simmons built a visualization dashboard using publicly available data that shows these comparisons and predictions (**csc2.ncsu.edu/faculty/healey/covid**).

Healey, a professor of computer science and Goodnight Distinguished Professor at the university's Institute for Advanced Analytics, says that he and Simmons, a teaching professor at the Institute for Advanced Analytics, built the dashboard to provide information that is hard to find elsewhere.

They focused on exploration and prediction — properties that visualization and analytics are well suited to provide.

Perhaps most interestingly, the dashboard predicts the flattening in a region's outbreak curve for both confirmed COVID-19 cases and for COVID-19 fatalities.

The dashboard also provides region-to-region comparisons of confirmed COVID-19 cases and fatalities. Users can compare different U.S. states or entire countries. Some larger countries are separated into regions for further context and specificity.

To provide additional context, the dashboard also includes case count and map visualizations.

The dashboard is updated daily as new numbers are made available. The researchers use data from the data.world Coronavirus (COVID-19) Case Counts site, which requires a free user account to access. ■

College places in Top 10 of best online programs

NC State's Engineering Online continues to receive high rankings from *U.S. News & World Report.*

The online engineering master's program offered by NC State was ranked seventh nationally in the *U.S. News & World Report* 2020 list of the Best Online Programs. NC State was ranked 15th on the list of Best Computer Information Technology Programs. In rankings of online engineering specialties, the College landed in the top 10 in civil, mechanical, electrical and industrial engineering.

The online graduate engineering program was also ranked sixth on a list of Best Online Graduate Engineering Programs for Veterans.

Established in 1978, Engineering Online is the College's master's degree or professional certificate distance education program. Engineering Online is fully accredited by the Commission on Colleges of the Southern Association of Colleges and Schools, and is authorized in every U.S. state for delivery of online degree programs.

Engineering Online offers 16 different graduate engineering degree programs that are the same high-quality engineering and computer science degree programs offered on campus, but with the flexibility of online learning to help meet students' educational and professional goals.

Though online students are welcome to visit campus during their enrollment, there is never any requirement to do so. All assignments are submitted and returned online, all lectures are available online and all student-faculty and student-student interaction is conducted online. Most of the mid-term and final exams must be administered by a proctor, but proctors are typically available in the student's workplace or community.

The *U.S. News & World Report* rankings look at metrics including faculty credentials and training, services and technologies made available to students, student excellence and how engaged faculty members are. ■
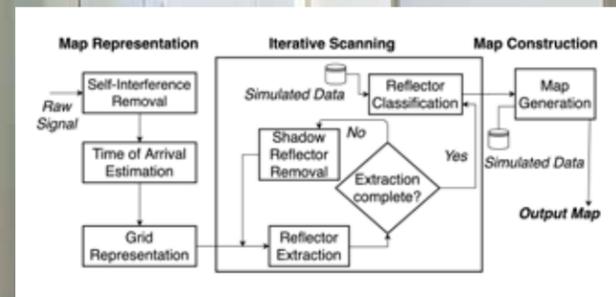
Mapping system will give first responders an important tool

Dr. Muhammad Shahzad, assistant professor in computer science, and research assistant Usman Khan have developed a system that generates maps of buildings without entering the building.

"Our project includes wireless-transmission equipment that uses radio frequencies. We set this equipment outside a building and it does a sweep of the entire building," Shahzad said. "By looking at the reflection of the signals that come back from objects within the building, we can take this information and construct a map of the insides of the building."

The team has designed a setup consisting of transmit and receive antennas that can be placed outside a building to generate its map. Once the setup is in position, the antennas rotate to scan the parts of interest of the building and measure the distances of different obstacles in the building using signal processing techniques. This setup operates at the frequencies of a few gigahertz, and at these frequencies, the walls and other indoor reflectors do not diffuse reflections in all directions. This means that the antennas receive reflections from only a few parts inside the buildings. This sparse information about the distances of different obstacles does not directly translate to complete maps. To overcome this challenge, the team developed intelligent machine learning approaches that take the information about sparse reflections as input and generate the map that best fits the sparse reflections.

According to Shahzad, this technology offers multiple benefits as it allows individuals to see the layout of a building before entering inside. Additionally, Khan adds that law enforcement and first responders would benefit greatly from this technology.

"First responders could use this technology at the scene to know what the building looks like inside, locate the different victims, and allocate their resources accordingly."

Shahzad said that first responders and law enforcement agencies inspired the idea for the project. After having discussions with fire departments and police departments regarding the need for a device that could generate maps without requiring personnel to enter a building, the team began to develop a solution that could make the operations safer for these agencies.

The project can currently generate maps of buildings for up to three levels of walls. However, in the future, the team hopes to increase the project's ability to generate maps past three levels. Additionally, Shahzad and Khan plan to upgrade the project so that it has the capability to locate entryways inside the building and pinpoint the exact locations of people, who may be trapped inside those buildings.

This work is supported in part by the US Army Research Office. ■
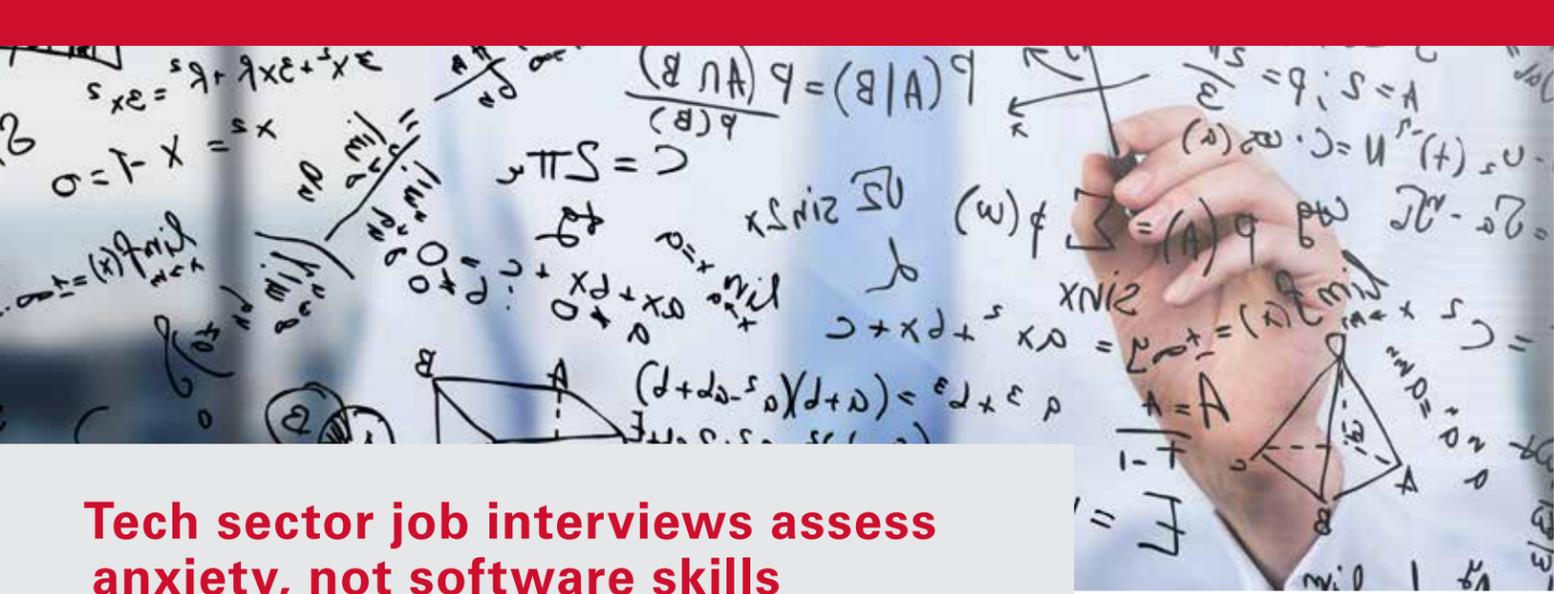
Tech sector job interviews assess anxiety, not software skills

A study from researchers at NC State partnering with Microsoft finds that the technical interviews currently used in hiring for many software engineering positions test whether a job candidate has performance anxiety rather than whether the candidate is competent at coding. The interviews may also be used to exclude groups or favor specific job candidates.

"Technical interviews are feared and hated in the industry, and it turns out that these interview techniques may also be hurting the industry's ability to find and hire skilled software engineers," says Dr. Chris Parnin, an assistant professor of computer science and co-author of a paper on the work. "Our study suggests that a lot of well-qualified job candidates are being eliminated because they're not used to working on a whiteboard in front of an audience."

Technical interviews in the software engineering sector generally take the form of giving a job candidate a problem to solve, then requiring the candidate to write out a solution in code on a whiteboard — explaining each step of the process to an interviewer.

Previous research found that many developers in the software engineering community felt the technical interview process was deeply flawed. So, the researchers decided to run a study aimed at assessing the effect of the interview process on aspiring software engineers.

For this study, researchers conducted technical interviews of 48 computer science undergraduates and graduate students. Half of the study participants were given a conventional technical interview, with an interviewer looking on. The other half of the participants were asked to solve their problem on a whiteboard in a private room. The private interviews did not require study participants to explain their solutions aloud, and had no interviewers looking over their shoulders.

Researchers measured each study participant's interview performance by assessing the accuracy and efficiency of each solution. In other words, they wanted to know whether the code they wrote would work, and the amount of computing resources needed to run it.

"People who took the traditional interview performed half as well as people that were able to interview in private," Parnin says. "In short, the findings suggest that companies are missing out on really good programmers because those programmers aren't good at writing on a whiteboard and explaining their work out loud while coding."

The researchers also note that the current format of technical interviews may also be used to exclude certain job candidates.

"For example, interviewers may give easier problems to candidates they prefer," Parnin says. "But the format may also serve as a barrier to entire classes of candidates. For example, in our study, all of the women who took the public interview failed, while all of the women who took the private interview passed. Our study was limited, and a larger sample size would be needed to draw firm conclusions, but the idea that the very design of the interview process may effectively exclude an entire class of job candidates is troubling."

What's more, the specific nature of the technical interview process means that many job candidates try to spend weeks or months training specifically for the technical interview, rather than for the actual job they'd be doing.

"The technical interview process gives people with industry connections an advantage," says Mahnaz Behroozi, first author of study and a Ph.D. student at NC State. "But it gives a particularly large advantage to people who can afford to take the time to focus solely on preparing for an interview process that has very little to do with the nature of the work itself.

"And the problems this study highlights are in addition to a suite of other problems associated with the hiring process in the tech sector, which we presented at ICSE-SES (the International Conference on Software Engineering, Software Engineering In Society)," adds Behroozi. "If the tech sector can address all of these challenges in a meaningful way, it will make significant progress in becoming more fair and inclusive. More to the point, the sector will be drawing from a larger and more diverse talent pool, which would contribute to better work."

The study was co-authored by Shivani Shirolkar, a Ph.D. student at NC State who worked on the project while an undergraduate; and by Titus Barik, a researcher at Microsoft and former Ph.D. student at NC State. ∎

Can a simple email encourage women to stay in a STEM program?

Although great efforts are being made to increase the number of women in science, technology, engineering and mathematics (STEM) jobs, statistics show that women occupy just 28 percent of STEM jobs and account for only 17 percent of computer science majors and 21 percent of engineering majors.

Researchers from NC State and Kent State University want to know what can be done to broaden participation in STEM fields and improve the persistence of women in computer science. Based on existing social-psychology theory and the results of their 2018 pilot study, they suspect that the differences in career choices arise partially from gender differences in self-assessment of STEM ability while in school.

The researchers have received almost $300,000 in grant funding ($174,938 to NC State; $125,062 to Kent State) from the National Science Foundation (NSF) to test whether educational institutions can use a simple, easy-to-implement intervention, such as an encouraging email message, to increase the participation of women in computer science and other STEM disciplines. Their two-year grant project, titled "Analysis of a Simple, Low-Cost Intervention's Impact on Retention of Women in Computer Science," is funded by the NSF Improving Undergraduate STEM Education: Education and Human Resources program.

Principal investigators of the study include Dr. Bita Akram, assistant teaching professor; Dr. Tiffany Barnes, professor of computer science; Dr. Thomas Price, assistant professor of computer science; and Dr. Lina Battestilli, associate teaching professor of computer science from NC State, along with collaboration from Dr. Susan Fisk, an assistant professor of sociology at Kent State.

To test their hypothesis on improving persistence, they are using a "lightweight" self-assessment intervention in introductory computer science courses, emailing students contextual information about their performance designed to improve their self-assessed ability. They will explicitly tell the student that they are "a top performer in the class and that they should consider getting involved in undergraduate computer science research."

Their project includes testing the self-assessment on a larger scale using:

- Field experiments in introductory computer science courses with approximately 2,800 students at NC State (including both majors and non-majors) to determine the effect of the self-assessment intervention on self-assessments of ability, persistence intentions, enrollments in follow-up computer science courses and involvement in undergraduate research.
- 60 qualitative interviews with students in the targeted introductory courses to understand the mechanisms by which the intervention succeeded, or reasons it failed.
- Online experiments at Kent State with 280 novice programmers to determine what kind of feedback is most potent at increasing self-assessments of ability.

Their 2018 pilot study involving 193 students in an introductory computer science course and conducted by Dr. Susan Fisk, Dr. Kathryn Stolee (associate professor at NC State) and Dr. Lina Battestilli showed that the intervention significantly increased all students' self-assessed computer science ability and it also increased women's persistence intentions. It also found that changing the wording of a single email increased women's computer science persistence intentions by 18 percent.

The researchers are also hoping that this project will help them understand how self-assessed ability impacts the persistence of other underrepresented and marginalized groups in STEM. ∎

Summer gaming program helps campers realize their potential

Lead counselor Nasir Jones stands at the front of the class, guiding the campers through coding exercises that are part of SNAP, a visual programming language. Three other counselors move among them answering questions.

The 12 campers are participating in the Bridge to Computing summer camp program for underserved 12- to 15-year-old boys held in the Department of Computer Science (CSC) at NC State.

According to Dr. Tiffany Barnes, a professor in the department who is in charge of the program, the very first camp was held in 2017. She said numerous groups have joined forces to keep this camp viable, including the partnering Raleigh Police Department (RPD) and Ronneil Robinson's Give Back Organization (GBO). Cisco largely funded the program this year.

Lt. Barbara Cojocar is with the RPD's Southeast District and oversees the department's involvement with the camp. She described how the idea for a computer gaming camp came about.

"Knowing that there were underserved children in the district and wanting to make sure they had productive activity during the summer to help them not be recruited into gang activity, we thought, what can we do that would be of interest to them," she said.

She explained that former police sergeant James Kryskowiak and Ronneil Robinson came up with the idea of a computer gaming camp originally called Games Over Gangs. The RPD eventually enlisted NC State as the camp venue.

The first year, RPD officers identified children and talked to parents, transported the children back and forth to camp, mentored them and picked up food for them provided by GBO through donors and volunteers. Now, they are out of the food loop but still select the children, transport them, chat and play football with them. Always they mentor them, focusing on values such as courage, fairness and integrity.

Barnes said that she saw the camp as an opportunity to reach out to children who don't typically think about computing as something they can do.

Growing up in a poor neighborhood, she said, "I always saw education as a way of not being poor… When I took a computer

science class in high school, which was required, I was really good at it, and I was like, 'I can do this,' but if I hadn't had that class, I don't know what I would be doing now."

Barnes said that the curriculum has evolved each year to provide the best possible experience for the campers. Barnes also realized that the campers related better to counselors closer in age from similar neighborhoods.

Jones comes from such a neighborhood in Greenville, NC. Marnie Hill, who taught computer science to Jones at J.H. Rose High School in Greenville and now works for Barnes as the program manager of a workshop for teachers, told Barnes about the great job Jones did in her classes.

Jones worked as a camp counselor last year and is this year's lead counselor. He's in his second year at North Carolina A&T State University (NC A&T) and plans to come to NC State as a graduate student in computer science. He had a large role in making this year's lesson plans and recruited the other counselors.

Two of the three other counselors also attend NC A&T: Kalyn Robertson is a sophomore majoring in supply chain management and Nelson Lee is a junior majoring in psychology. Arquavion Page, also taught by Hill, is now in his first year at Pitt Community College majoring in computer science with a full scholarship. Hill mentored the four counselors.

The three-week camps are made up of a variety of activities from basic typing to leadership activities. The lessons center around computer science, sometimes in the form of games, but there are also field trips, speakers and breaks for football.

The campers build their skills so that by the end of camp they have produced projects with SNAP. They present the projects on the last day to an audience that includes their parents.

The counselors, in addition to keeping the campers on task with their lessons, take advantage of teachable moments.

Lee gave an example. During some free time, the campers were playing a song by YNW Melly called "Mama Cry." Robertson asked how the so-called thug lifestyle appeals to them through music. Some thought it seemed cool because of the money, cars, girls and friends. The counselors asked them to pay attention to lyrics — not just the beat — because they often reveal the harsh reality of the lifestyle.

These camp counselors, RPD officers, Ronneil Robinson, donors, Barnes, Hill and more say they care deeply about the success of this program and are committed to helping these young men realize their full potential. ∎

Among B.S. NC State grads, computer science alumni earn highest median starting salary

By fully embracing and living out the "Think and Do" mission of NC State, the December 2019 Department of Computer Science B.S. graduates are experiencing unprecedented success. Their average median starting salary was an astounding $81,250. This was the highest median salary of all NC State departments in December 2019. Additionally, to our knowledge, this is the highest median salary ever reported for an undergraduate discipline at NC State.

These graduates have accepted jobs at high-profile companies such as Fidelity Investments, IBM, Cisco Systems, Allstate, LexisNexis and SAS Institute. They will continue to "Think and Do" as software engineers, business technology analysts, software developers and data analysts. The diversity of careers of this class shows that a B.S. from the CSC department has an infinite amount of applications; the options are endless, and success is guaranteed.

Additionally, 22 percent of the December 2019 class reported that they will attend graduate school to obtain their master's or doctoral degrees. We are so excited to see what they will accomplish as they continue their education.

Living during the COVID-19 crisis has proven quite difficult, and across the nation students' plans for internships and jobs have been canceled. However, for the CSC department at NC State, an overwhelming majority of our ePartners proceeded with the summer hire plans. This has allowed interns and new graduate hires to work remotely. While some start dates were altered or delayed, the overall impact that COVID-19 has had on CSC students and graduates has been minimal-especially compared to other disciplines.

The department is incredibly proud of our students and graduates and applaud them for their hard work and perseverance. ∎

Seven alumni inducted into the CSC Alumni Hall of Fame

The NC State Computer Science Alumni Hall of Fame officially inducted seven new members during a special ceremony held at the Park Alumni Center on Thursday, Oct. 10th. More than 70 faculty and staff members joined award winners, their families and special guests.

The CSC Alumni Hall of Fame was established in 2017 to celebrate and recognize the exemplary contributions our outstanding graduates have made to their profession, their community and to the world at large. With more than 9,600 CSC alumni, only a select number will be chosen for recognition in our Alumni Hall of Fame, making this a truly exceptional and noteworthy honor.

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

The 2019 inductees into the NC State Computer Science Alumni Hall of Fame include:

- **Michael DeHaan** (B.S. '01) – Founder, Ansible
- **Sven-Thorsten Dietrich** (B.S. '94, M.S. '97) – Vice president, Office of Architecture, State Street Bank
- **Steven Grobman** (B.S. '94) – Senior vice president and chief technology officer, McAfee
- **John O'Neill** (B.S. '96) – Founder, Spark Plug Games
- **Chris Olinger** (B.S. '89) – Co-founder and chief technology officer, d-Wise

- **Susan Rodger** (B.S. '83) – Professor of the practice in the Department of Computer Science, Duke University
- **Nicki Washington** (M.S. '02, Ph.D. '05) – Associate professor in the Department of Computer Science, Winthrop University

In addition, the department recognized one Outstanding Young Alumnus, a CSC graduate who has graduated within the past 10 years:

- **Bradley Herrin** (BS '11) – Senior software engineer and master innovator, IBM

CSC Department head Dr. Gregg Rothermel was on hand to congratulate and take pictures with the honorees during the special ceremony in the Park Alumni Center's Grand Ballroom. Rothermel said, "This truly is an outstanding group of alumni who have represented NC State Computer Science well. This impressive group serves as an inspiration for us all – faculty, staff and students."

Ken Tate, director of engagement and external relations, says "This is a most impressive class of inductees, a group of innovators with over 100 U.S. and International patents, of authors who have left their mark on this world through the published word, of entrepreneurs with multiple start-ups, of researchers with a focus on diversity in STEM, and of trend-setters who have developed technology and standards that are used by the masses. In some way, shape or form, every one of our inductees have done things that have positively impacted the world we live in."

But Tate adds, "With more than 9,600 alumni scattered all over the globe, we don't know about everyone's accomplishments."
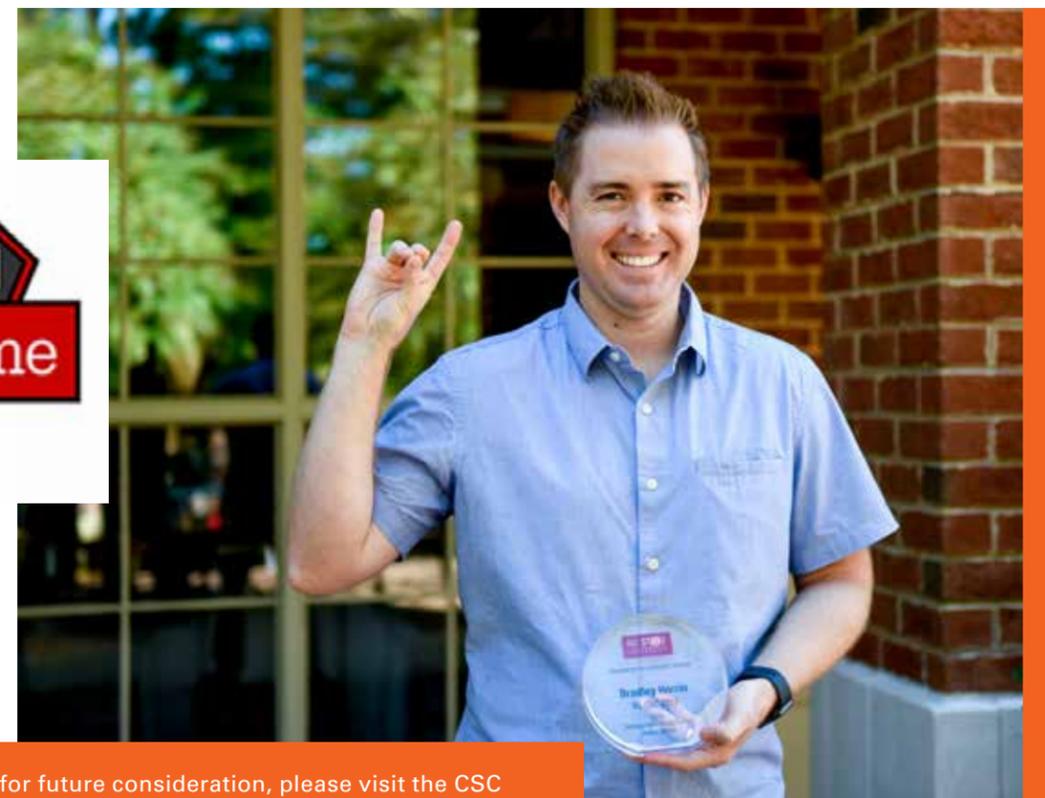
To nominate someone for future consideration, please visit the CSC Alumni Hall of Fame page. (**csc.ncsu.edu/alumni/hall-of-fame.php**) ■

Bradley Herrin

Alumna makes lead gift to help establish endowment honoring Dr. Alan L. Tharp

Marcia McLawhorn

Dr. Alan Tharp

The department is pleased to announce efforts have officially been launched to establish the Dr. Alan L. Tharp Undergraduate Innovation Endowment in honor of previous department head and alumni distinguished professor Dr. Alan L. Tharp.

The proposed endowment will provide funds of a "programmatic" nature, with a preference toward supporting and encouraging undergraduate research and innovation. In particular, the vision is that the endowment will provide unrestricted funding annually that the CSC director of undergraduate programs can use to support undergrad research and other special needs relative to nurturing innovation. Some possible uses may be to provide travel funds for a student to present a refereed paper at a conference, to purchase special materials as part of a project that he or she might not be able to undertake otherwise, or to file a provisional patent.

The proposed endowment, which requires a minimum of $50,000 to officially be launched, has been seeded by a $12,000 gift from computer science alumna Marcia G. McLawhorn (B.S. '70). McLawhorn says the gift is a tribute to Tharp's creative ideas and the immense impact he had on her life and career. "I'm sure he impacted many others in a similar way, and I hope this endowment allows him to have a positive influence on future generations of computer science students," McLawhorn says.

McLawhorn was the first person in her family to attend college and chose a major that was heavily male-dominated. When she first attended NC State, women made up only 1/12 of the entire student population. The Department of Computer Science included an even smaller percentage of women. In fact, McLawhorn was not only one of the earliest graduates from the department, but she was also one of the first female graduates, paving the way for future female CSC students. After graduating in 1970, McLawhorn leveraged her degree in the relatively new discipline to launch a very

"His class showed how a computer could seem like a human and opened up my creative thought process, teaching me that a machine can be coded to behave like a human."

Marcia G. McLawhorn

successful career starting at the NC State Biology and Agricultural Department and ending in her retirement from the American Medical Association.

Although McLawhorn has been retired for more than 20 years, she has not stopped pursuing knowledge. She has stayed busy taking community college courses and pursuing hobbies like genealogy and photography.

McLawhorn fondly remembers Tharp as the one who introduced her to the full potential of computing. Before meeting Tharp, she thought of computers as big calculators. However, while taking a course taught by Tharp, McLawhorn was pushed to expand her perspective. "Dr. Tharp's Artificial Intelligence class opened up a window to innovation... I began to see that computers were more than just calculators. His class showed how a computer could seem like a human and opened up my creative thought process, teaching me that a machine can be coded to behave like a human."

Tharp, who earned his Ph.D. in computer science from Northwestern University, joined the department in 1969, just two years after the department's official establishment, becoming one of the very first faculty members in the department with a degree in the field.

As his career progressed, Tharp took on ever-increasing levels of leadership within the department. After serving as interim department head for a year, he became just the fourth official

department head in 1993. Serving in this capacity until 2004, Tharp led the Department of Computer Science during a period of incredible growth and transition.

During his tenure as department head, 29 tenure-track faculty members were recruited (17 of them received the NSF CAREER development award) and the department established an active Strategic Advisory Board, launched the award-winning Senior Design Center (SDC) to manage corporate-sponsored student projects and established the highly successful ePartners corporate recognition program. Both the undergraduate and graduate programs grew significantly during the period, and much of the groundwork was completed to move the department into a new facility on Centennial Campus.

Tharp, who retired from the department in 2010, is still active in the department's SDC. He is not only remembered for his excellent leadership as department head, but he is also remembered as a stellar teacher who passionately cared about his students. In recognition of his achievements as an educator, he received the NC State University Alumni Association's Distinguished Undergraduate Professorship Award in 1985.

McLawhorn's gift toward the endowment stems from her desire to help students reach their full potential. "I prefer not to just give a donation, I like fulfilling someone's dreams." She also calls on others to fulfill dreams, "I want other people who enjoyed their time under Dr. Tharp to contribute. The funds will be used to support students' innovation and will reflect Dr. Tharp's own passion for innovation."

As word of McLawhorn's lead gift has filtered out, others have followed her lead to make gifts and the total given to date is approaching $15,000.

Individuals or corporations interested in contributing to this fund can send a check made payable to the "NC State Engineering Foundation" noting for the "Dr. Alan Tharp Endowment - COE / CSC" in the memo section. **Donations can be sent to the NC State University, Gifts and Records Management, Campus Box 7474, Raleigh, NC 27695-7474**.

If you are interested in learning more about ways to support and /or become better engaged with the Department Computer Science at NC State, please contact Sara Seltzer, director of development, at **sara_seltzer@ncsu.edu** or **919.515.3730**. ∎

Rahman receives COE Distinguished Dissertation Award

Dr. Akond Rahman, an assistant professor in the Department of Computer Science at Tennessee Technological University and 2019 NC State Ph.D. graduate, has received the College of Engineering's 2020 Distinguished Dissertation Award.

Rahman's dissertation, "Anti-patterns in Infrastructure as Code," dealt with infrastructure as code (IaC) scripts. IaC scripts are used to create and manage automated deployment pipelines that allow information technology organizations to continually deploy software changes to their customers. Rahman's research worked to identify anti-patterns, or recurring practices with negative consequences, allowing developers to take informed actions in creating and maintaining scripts without the kinds of defects that can lead to wide-spread system outages and service discrepancies.

Rahman has also been put forward by the University as a nominee for the Council of Graduate Schools/ProQuest Distinguished Dissertation Award.

A native of Bangladesh, Rahman earned an undergraduate degree at Bangladesh University of Engineering and Technology and a master's at the University of Connecticut. At NC State, he was advised by Dr. Laurie Williams, Distinguished Professor in the Department of Computer Science.

Other nominees for the COE award were:

- **Dr. Vasudev Pralhad Haribal**, a Ph.D. graduate from the Department of Chemical and Biomolecular Engineering — "Light Alkane Valorization using a Redox Approach"
- **Dr. Hui Guan**, a Ph.D. graduate from the Department of Electrical and Computer Engineering — "Reuse-Centric Programming System Support of Machine Learning"
- **Dr. Nrup Balar**, a Ph.D. graduate from the Department of Mechanical and Aerospace Engineering "Thermomechanical Behavior of Semiconducting Polymers"
- **Dr. Aysenur Toptan**, a Ph.D. graduate from the Department of Nuclear Engineering — "A Novel Approach to Improve Transient Fuel Performance Modeling in Multi-Physics Calculations" ∎

as a young boy and wanting to understand how a gadget like an Xbox worked.

> "For me, it was fun because I was able to take what I was learning in my classes during the week and scale it down to a place where middle school students could understand the basics of computer science,"

KaMar Galloway

Galloway's curiosity followed him to NC State. During his time as an undergraduate, he, along with friend and NC State CSC Department alumna Khalia Braswell, worked under Dr. Fay Cobb Payton to create MyHealthImpactNetwork. This is an interactive website that focuses on health care issues and disparities that target Black female college students, in particular, and college-aged students, in general.

Galloway was also heavily involved with the STARS Computing Corps, an organization that he states had a significant impact on his career path. STARS aims to foster meaningful relationships between student mentors from the Department of Computer Science and under-represented children in the local community to promote the message that all children can be computer scientists. During his time with STARS, Galloway mentored students from a school in Durham, NC. He and his team worked together to produce fun and innovative lessons to teach the students how to think and code like computer scientists.

One Saturday a month, the school would bring their students to NC State's campus to participate in hands-on activities like building a website using HTML or using Lego Mindstorms to code robots.

"For me, it was fun because I was able to take what I was learning in my classes during the week and scale it down to a place where middle school students could understand the basics of computer science," says Galloway.

Perhaps the most meaningful aspect of STARS was the students. Through STARS, they were not only given the opportunity to learn about the many applications of computer science, but were able to see that college was an attainable goal, and that they could succeed in the field of computer science.

After two years of serving as a STARS mentor, Galloway was asked to take on the role of the lead coordinator. This was a pivotal moment in his life as it began to propel him toward pursuing a career in teaching kids computer science.

After graduating from NC State, Galloway joined Google's Computer Science Teaching Fellows, a two-year program with the goal of teaching children computer science skills. During this time, Galloway chose computer science and technology education as his path forward.

"I realized that this was a space I had a lot of expertise in because I was able to grasp difficult concepts as a college graduate and make them fun and engaging for kids. I really wanted to focus on the teaching aspect of computer science because it was fascinating and it was a growing field."

When Galloway finished his time as a Computer Science Teaching Fellow, he continued his career at Google by helping to establish the CS First program. The focus of CS First is to teach elementary-age children how to program using Scratch, a platform that uses drag-and-drop blocks to create code, all while leaning into students' interests such as music, fashion and sports. Building the curriculum around these interests ensured that students were able to see how computer science might apply to their own lives and passions. Now the program has expanded into formal education subject-areas, like English Language Arts.

> "Giving back to a university that gave me so much will hopefully encourage other alumni to give, and will encourage the university to expand its commitment to the Black community."

KaMar Galloway

After CS First, Galloway continued this computer science education trajectory, with the goal of supporting students as they moved on to middle and high school. At first, his team began planning to establish a new program for older students that used text-based programming. However, his team began to realize that many students lacked digital literacy skills.

"We felt like it would be a missed opportunity to skip over students that weren't taught those skills and jump right into computer science... Not every kid will go on to pursue a career in computer science, but all kids should have the basic digital literacy skills to be successful in their careers and life."

This led to the establishment of the Applied Digital Skills program, which aims to teach kids how to use digital applications to better their lives. This program specifically focuses on creatively teaching kids basic digital literacy skills on a computer. These skills include managing a budget in

spreadsheets, organizing information through presentations and many others. "One of my favorite lessons teaches students how to analyze an online scam to identify warning signs and follow best practices to stay safe online," says Galloway. In the lesson, students get to choose their own online scam to analyze. As an avid sneaker collector, Galloway shared his own example of being scammed while reselling a pair of sneakers online to connect the lesson to real-world experiences. "Not only do students walk away with digital skills, but they also learn practical life skills along the way." Besides creating the curriculum for the Applied Digital Skills program, Galloway has even had the great opportunity to star in some of the videos (**doodles.google.com/d4g/educators**).

Applied Digital Skills is a free, video-based curriculum that prepares students of all ages for careers that require basic digital skills through hands-on problem solving and collaborative lessons. Teachers can use this curriculum in their classrooms as a supplement so students learn these practical life skills without having to rely on a standard textbook. Students can watch these videos at their own pace and are given real-time practice. Especially now, during the COVID-19 pandemic, Applied Digital Skills supports teachers and provides students with free and easy-to-use resources.

Recently, as part of Google's commitment to deepening its impact in the community, Galloway is leading a project to reach 400,000 Black students around the country affected by racial inequalities in education. The Applied Digital Skills program will play a huge role in reaching Black students specifically, so that they can be supported and successful in their academic and career endeavors.

Galloway is always looking to better the lives of students, which is quite evident in the projects he takes on, and the legacy he's leaving at NC State. "Giving back to a university that gave me so much will hopefully encourage other alumni to give, and will encourage the university to expand its commitment to the Black community."

Because of his commitment to creating a safe place where all students, young and old, see computer science and technology as a viable and exciting career, Galloway was recognized by the department as one of six Outstanding Young Alumni during the inaugural CSC Alumni Hall of Fame induction in 2017.

"Many of the kids entering elementary school will work in jobs that don't exist yet. In fact, tomorrow's jobs will allow greater flexibility in picking your schedule and choosing where to work. That's a scary scenario — not knowing how to prepare for an ever-changing world! I'm encouraged and motivated to help kids build their capacity to learn new digital skills and be a part of the future." ▪

From Gadgets to Google

KaMar Galloway

Ever since graduating from NC State in 2013 with his bachelor's degree in computer science, KaMar Galloway has been leveraging his degree, experiences and passions to innovatively help students and teachers by creating impactful projects to bring about change in education.

Galloway has always been fascinated by the inner workings of technological devices — it's what inspired him to go into the field of computer science. A native from the beautiful island of St. Croix, Galloway was first intrigued by the Super Nintendo, a popular 90's video game system. When not eating sweet plantains, he would marvel at the gameplay and storytelling behind Donkey Kong Country. "I would play for hours on end," says Galloway. His intrigue for video games continued as he grew older and moved on to more modern consoles. He fondly remembers flipping through Circuit City ads in the newspaper

New faculty members join department

The department is welcoming three new members to the faculty. **DR. XU LIU** has joined the department as an assistant professor and **DR. SHUYIN JIAO** is a new teaching assistant professor. **DR. THIERRY WANDJI KETCHIOZO** is CSC's first director of cybersecurity education.

Dr. Xu Liu

Dr. Shuyin Jiao

Dr. Thierry Wandji Ketchiozo

LIU received his B.S. in software engineering from Beihang University. He received his M.S. in computer science from Chinese Academy of Sciences and a Ph.D. in computer science from Rice University. Prior to joining the NC State faculty, he was an assistant professor at the Department of Computer Science at the College of William & Mary.

He works on building performance tools to pinpoint and optimize inefficiencies in HPC code bases. He has developed several open-source profiling tools, which are world-widely used at universities, DOE national laboratories, and industrial companies. Liu has published a number of papers in high-quality venues. His papers received best paper award at SC '15, PPoPP '18, PPoPP '19, and ASPLOS '17 Highlights, as well as a Distinguished Paper Award at ICSE'19. His recent ASPLOS '18 paper has been selected as ACM SIGPLAN

Research Highlights in 2019 and nominated for CACM Research Highlights.

He is the recipient of a 2019 IEEE TCHPC Early Career Researchers Award for Excellence in High Performance Computing.

Liu's research interests lie in program analysis in high-performance computing systems.

JIAO joined the department in fall 2020 as a teaching assistant professor. She received her B.S. in materials science and engineering from Beihang University in China, her Diplome Grande Ecole in Engineering from Ecole Centrale de Lyon in France, and her Ph.D. from the University of Houston (2015). Prior to coming to NC State, she was a teaching faculty in the College of William & Mary, and before that, she was a research assistant at the University of Houston. She

received an ABS Scholarship and Amoco Minority Scholarship in 2014, and a Kalsi Research Award in 2012. Her research interests are in program analysis and computer science education.

KETCHIOZO holds a bachelor's degree from University of Montreal, master's degrees from Morgan State University and University of Maryland University College (UMUC) and a Ph.D. from George Washington University. He has worked in private industry and has held senior positions as a researcher and software and systems engineer for the U.S. Naval Research Laboratory and Naval Air Systems Command. He has also held teaching positions in the area of cybersecurity at Morgan State and UMUC.

Chris Gurley, second from right.

CHRIS GURLEY WINS IT TEAM SERVICE AWARD

IT Linux administrator in the department Chris Gurley is part of the Campus Linux Team (CLS) that recently won the IT Extraordinary Team Service Impact Award. Gurley, who is a 2015 graduate of the department, has been employed by CSC since his graduation.

The inaugural NC State IT Community Awards aim to recognize teams and individuals that have made a significant collaborative impact within the IT community. Nominees in four categories were recognized at the IT Community Event on November 20, 2019. The four categories are: Extraordinary Project Team Impact Award, Extraordinary Team Service Impact Award, Team Player Award and Rising Star Award.

The Extraordinary Team Service Impact Award recognizes a team that has functioned exceptionally well and collaborated within and across organizational structures in fulfillment of its operational responsibilities. The criteria for selection focused on exemplary IT operational support as shown through examples of service improvements, innovation or problem solving that were achieved through teamwork and collaboration.

Congratulations to all the CLS team members including Tom Farwig, Matt Fields, Gary Gatling, Dan Green, Tremaine Grimes, Chris Gurley, Daniel Henninger, Daniel Lucio, Kirk Main, Joshua Snapp and Dustin Wheeler.

Dr. Carla Savage

AWESOME SERVICE TO CSC RECOGNIZED WITH THE CARLA SAVAGE AWARDS

The NC State Computer Science Department, like many other departments at NC State, has groups of people who accomplish great things. Examples include taking over when others are sick, doing a brilliant job on a large departmental infrastructure project, performing magic with grant paperwork, scoring a new large grant, winning a prestigious award at a conference or being a great supervisor.

Little was being done to recognize this outstanding service on an ongoing basis. So, representatives in the department created the Carla Savage Awards, a new intra-departmental initiative to recognize outstanding achievement and special people within the department, in the spirit of the incomparable department icon Dr. Carla Savage.

Savage, a professor of computer science at NC State, joined the department in 1978. She was recently named a Society for

Dr. Sarah Heckman

Dr. Alessandra Scafuro

Dr. Emerson Murphy-Hill

Industrial and Applied Mathematics (SIAM) Fellow, Class of 2019. She was recognized for outstanding research in algorithms of discrete mathematics and in computer science applications, alongside exemplary service to mathematics. And, in 2012, she was named to the inaugural class of Fellows of the American Mathematical Society (AMS). The Fellows of the AMS designation recognizes members who have made outstanding contributions to the creation, exposition, advancement, communication and utilization of mathematics. In February 2013, Savage was named secretary of the American Mathematical Society. In the years since the Society was formed in 1888, there have only been nine secretaries; Savage becomes the tenth. Savage entered phased retirement from NC State in 2018-2019.

Each month, nominations for the Carla Savage Awards will focus on one of the following groups: Ph.D. students, administrative staff, research professors, teaching professors, assistant professors, associate professors and professors.

The Carla Savage Awards committee is made up of representatives from the faculty, staff and graduate students. The names of nominators for the awards are kept private, but the nomination text will be public so voters can access this information when voting. Voting is open to everyone in the department. Two awards will be given each month, with a maximum of 14 winners (one person cannot win more than once every six months). No awards will be given in January, June, July, August or December.

The March 2020 Inaugural Carla Savage award winners were: Leslie Rand-Pickett, director of Graduate Career Services, who was named the Most Awesome Administrative Person, and Dr. Emerson Murphy-Hill, staff research scientist, former CSC faculty member and a member of Google's Engineering Productivity Research Team, who was named the Most Awesome Adjunct Professor.

The April 2020 winners were Dr. Sarah Heckman, teaching professor and director of undergraduate programs, and Dr. Alessandra Scafuro, assistant professor.

Dr. George Rouskas

ROUSKAS RECOGNIZED FOR OUTSTANDING SERVICE TO ONTC

Dr. George Rouskas, director of graduate programs and Alumni Distinguished Graduate Professor of Computer Science, received the 2019 Outstanding Service Award from the Optical Networking Committee (ONTC) of the IEEE Communications Society at the 2019 IEEE GLOBECOM conference.

This award recognizes members of the IEEE Communications Society who have a distinguished record of service to the Optical Networking Technical Committee (ONTC), providing exceptional leadership within ONTC, and promoting the ONTC activities and interests in the broader community. Rouskas has been a member of the ONTC for over 20 years serving as secretary from 2012-2013; vice chair from 2014-2015; and chair from 2016-2017.

The Optical Networking Technical Committee serves as the IEEE Communications Society's focal point in the area of optical networking technologies. The technical committee plays an active role in stimulating and organizing leading-edge optical networking symposia, workshops, sessions and tutorials at ICC and Globecom, and in particular serving OFC and other premier M&C venues. ONTC also works with the publication departments of the Communications Society, existing Communications Society technical committees and related societies to organize timely journal and magazine publications, including online publications at the Communications Society portal. The Technical Committee also serves as a proactive facilitator in the dissemination of evolving optical networking standards by working closely with standards forums such as OIF, IETF, and ITU/T1.

Leslie Rand-Pickett

RAND-PICKETT NAMED CSC'S 2019-20 PEP AWARD WINNER

Leslie Rand-Pickett joined the department in 2016, launching the new CSC Corporate & Career Services suite, providing essential career services programs and unique offerings to our growing graduate program of more than 700 students. At the time of its launch, the 700-square-foot suite, complete with offices and two high-tech interview rooms equipped with HD monitors and connections to support video-based remote interviews, was the first known department-centric career services suite on NC State's campus.

A true "champion of change," Rand-Pickett has identified and leveraged new technologies to provide value-based career services that not only scale to meet the needs of such a large group of constituents, but she does so in a highly customized and personal way providing impact for each individual student. She developed the very popular Navigating Networking Event, which offers graduate students an opportunity to gain insights into the proper etiquette for business receptions/networking events, and also how to best leverage these events to expand their network.

She has provided a variety of "high-tech virtual-high-touch" services that have been especially helpful to students impacted by the COVID-19-related "shelter-in-place" restrictions. For instance, she has launched a number of very popular virtual workshops for students, such as "How to Succeed in a Remote Work Environment," "Job Searching in a Tough Economy" and "Leveraging LinkedIn & ePACK." Moving to online appointments during the COVID response didn't slow down demand for student career advising. In fact, there was a 34-percent increase in students served in April 2020 vs. April 2019. Her office tracked more than 2,025 CSC student contacts with CSC Career Services programs and advising during the 2019-20 academic year.

In spring 2020, Rand-Pickett was recognized as one of the inaugural winners of the Carla Savage Awards, winning the Most Awesome Administrative Person award. In her nomination, one student commented recently, "She has been there for me through the career-related struggles, achievements and tea time conversations. She makes a great effort to connect with and help the students which is much appreciated. She's awesome!" Another commented, "She is also very optimistic and always ready to help. I remember once, I had an interview scheduled in an hour and the room I had booked in the library did not have mobile signal and she was able to arrange an interview room for me within 15 minutes."

Rand-Pickett's contribution to the department extends far beyond the duties and responsibilities of her job description. She has become a driving force, co-coordinating the department's presence and participation in the annual Grace Hopper Celebration of Women in Computing conference. She coordinates the department's annual Progressive Undergraduate Recruiting Dinner. And she works closely with the External Relations team to represent the department in discussions with current and prospective corporate partners. She has also become a key resource that the University's Partnership Office has come to rely heavily on as they collaborate with the NC Department of Commerce in activities designed to attract new corporations to North Carolina.

Prior to joining the department, Rand-Pickett had more than a decade's experience in NC State's Career Development Center (CDC) in both employer relations and career advising capacities. In the CDC, she consulted with employers to develop strategies for recruiting NC State students for internship, co-op and full-time positions across the university, and managed the ePACK jobs and internships database. Her career advising experience includes six years as a liaison to engineering students at NC State, and six years working with nursing and social science students at UNC Wilmington.

Dr. Munindar Singh

SINGH RECEIVES ACM/SIGAI AUTONOMOUS AGENTS RESEARCH AWARD

Dr. Munindar Singh, Alumni Distinguished Graduate Professor of Computer Science, has received the 2020 ACM/SIGAI Autonomous Agents Research Award. This award acknowledges Singh's extensive contributions to our understanding of social interaction and autonomy in Artificial Intelligence through his seminal work on interaction protocols, norms, and trust in multiagent systems. This work pioneered new approaches to thinking about sociotechnical systems in a formal and verifiable manner. The broad impact of the work has extended far beyond the agent community to encompass concerns in service-oriented computing, software engineering, and distributed computing. In addition, Singh has served the autonomous agents research community in a variety of roles, including as general chair of AAMAS 2005, a charter member of the editorial board of JAAMAS, and an IFAAMAS Board member.

ACM SIGAI, in collaboration with the International Conference on Autonomous Agents, in 2000 instituted this annual award for excellence in research in the area of autonomous agents. The award is intended to recognize researchers in autonomous agents whose current work is an important influence on the field. The award is an official ACM award, funded by an endowment created by ACM SIGAI from the proceeds of previous Autonomous Agents conferences. Prior to 2014, it was known as the ACM/SIGART Autonomous Agents Award.

CONGRATULATIONS TO OUR 2019-20 ACM/AITP FACULTY AND STAFF AWARD WINNERS

For decades, computer science students and faculty and staff members at NC State have celebrated the end of the academic year with a pig pickin' on the last day of spring classes. This highly anticipated CSC tradition, hosted by the Association for Computing Machinery / Association of Information Technology Professionals student organization, also provides students the opportunity to recognize outstanding faculty and staff members in the department.

Like so many other spring events, the year-end pig pickin' was canceled due to the COVID-19 crisis, however voting on the faculty and staff superlatives still took place.

Our students have spoken and here are the winners of the 2019-20 awards:

- Most Receptive Undergraduate Professor Outside of Class - Dr. Guoliang Jin, assistant professor
- Most Receptive Graduate Professor Outside of Class - Dr. Edward Gehringer, professor
- Outstanding Undergraduate Computer Science Staff Member - Ms. Zelda Tuazama, undergraduate secretary in the CSC Advising Office
- Outstanding Graduate Computer Science Staff Member - Ms. Leslie Rand-Pickett, director of Graduate Career Services
- Carol Miller Outstanding Undergraduate Lecturer - Dr. Anupam Das, assistant professor
- Carol Miller Outstanding Graduate Lecturer - Dr. Rada Chirkova, professor
- Joyce Hatch Service Award - Ms. Tammy Coates, assistant director of External Relations ▪
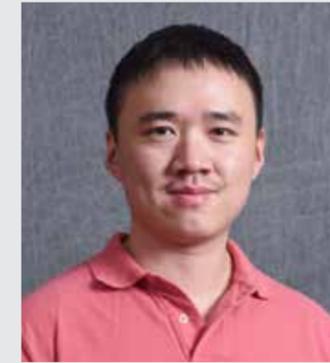
Dr. Guoliang Jin, Most Receptive Undergraduate Professor

Dr. Anupam Das, Carol Miller Outstanding Undergraduate Lecturer

Dr. Ed Gehringer, Most Receptive Graduate Professor

Dr. Rada Chirkova, Carol Miller Outstanding Graduate Lecturer

Zelda Tuazama, Outstanding Undergraduate Computer Science Staff Member

Tammy Coates, Joyce Hatch Service Award

2019-20 ACM / AITP FACULTY AND STAFF AWARD WINNERS

Ryan Catalfu

STUDENT BECOMES TEACHER

When he received an English assignment to identify a problem that could be solved through written form, NC State computer science major Ryan Catalfu tackled it the best way he knew how: by building a website.

Little did he know that his class project would be broadcast on the local news and, as a result, reach a lot more people than he could have imagined.

"Almost every situation that directly impacts large numbers of people right now involves COVID-19," he says. "I couldn't solve the health issues and felt there were a lot of sites that already offered guidance on symptoms, safety precautions, restrictions, etc."

So, Catalfu decided to focus on education. As the son of a former elementary school teacher, he says the decision came naturally. But he also really wanted to find a way to help as many people as possible, especially those suddenly faced with the prospect of homeschooling their children.

Parents, rejoice.

Catalfu's site — Elementary Education at Home (**spark.adobe. com/page/ZPfRtuXjvL2w7**) — offers resources on everything from stress management to teaching techniques, along with a slew of subject-matter sample activities and educational technology resources. There's even advice on how to establish a new routine and set up your child's workspace.

He designed and built the entire site from scratch, focusing on the most effective and useful ways to present the information — without overwhelming his already overwhelmed audience. Catalfu conducted online research and used a number of other resources to develop the content, including his former teachers, family and personal experience gained in classes and STEM camps.

Nearly 3,000 people have visited the site since its May launch.

"Although I do hope that COVID-19 is not still an issue going forward, I want to continue to help people," Catalfu says. "I am majoring in computer science with minors in environmental science and graphic communications. My goal is to blend my love of technology with my passion for protecting the environment and strengthening education in my future."

PAPER WINS BLUE SKY AWARD AT AAMAS 2020

A paper written by a team of researchers from NC State and the Delft University of Technology won the Blue Sky Award in the Blue Sky Track of the 19th International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS 2020) held in Auckland, New Zealand in May 2020.

The paper's authors are: NC State computer science Ph.D. graduate Dr. Pradeep Murukannaiah (currently an assistant professor at the Delft University of Technology in the Netherlands); Nirav Ajmeri, a postdoctoral research scholar in the NC State CSC;

Catholijn Jonker, professor at Delft University of Technology; and Dr. Munindar Singh, Alumni Distinguished Graduate Professor of Computer Science at NC State.

This award was sponsored by the Computing Community Consortium (CCC), a part of the Computing Research Association. The CCC's mission (**cra.org/ccc/about**) is to catalyze the computing research community, enabling the pursuit of innovative, high-impact research.

The winning paper is "New Foundations of Ethical Multiagent Systems." The abstract follows:

Ethics is inherently a multiagent concern. However, research on AI ethics today is dominated by work on individual agents: (1) how an autonomous robot or car may harm or (differentially) benefit people in hypothetical situations (the so-called trolley problems) and (2) how a machine learning algorithm may produce biased decisions or recommendations. The societal framework is largely omitted. To develop new foundations for ethics in AI, we adopt a sociotechnical stance in which agents (as technical entities) help autonomous social entities or principals (people and organizations). This multiagent conception of a sociotechnical system (STS) captures how ethical concerns arise in the mutual interactions of multiple stakeholders. These foundations would enable us to realize ethical STSs that incorporate social and technical controls to respect stated ethical postures of the agents in the STSs. The envisioned foundations require new thinking, along two broad themes, on how to realize (1) an STS that reflects its stakeholders' values and (2) individual agents that function effectively in such an STS.

AAMAS is the leading scientific conference for research in autonomous agents and multi-agent systems.

Colton Botta

CSC GRADUATE WINS OUTSTANDING SENIOR AWARD

Colton Botta, a December 2019 graduate from the department, received one of the College of Engineering's four Outstanding Senior awards for the 2019-20 academic year.

Each spring, the College of Engineering bestows Outstanding Senior Awards to four exceptional students in the categories of Citizenship and Service, Humanities, Leadership and Scholarly Achievement.

Botta received the Senior Award for Scholarly Achievement.

Academic departments within the College nominated seniors in all four categories. Winners and nominees are traditionally recognized at an annual awards reception, but due to COVID-19 and social distancing guidelines, the event was cancelled and seniors were recognized during a virtual event in May.

Botta is an exemplary December 2019 graduate of the Department of Computer Science who has exceptional academic performance, as is seen in his completion of the University Honors program and Computer Science Honors program. While maintaining his 4.0 G.P.A., Botta held the position of Computer Science Ambassador, was a member of Tech at NC State's Executive Board, an active member of the Artificial Intelligence Club and was a member of Phi Kappa fraternity. Additionally, he was published in the IEEE International Conference on Software Engineering.

Botta's research experience involvement spans across the university. With a minor in business entrepreneurship, he has proved himself as a proactive learner and valuable team player in the Entrepreneurship Clinic. He has worked with Dr. Tim Michaelis on a research project focused on cataloguing all academic work associated with stress and entrepreneurial well-being; participated in REU Site: Science of Software at NC State; and attended the ICSE 19 Student Mentoring Workshop — expanding on his research of investigating learning multiple programming languages and how to teach them more efficiently.

He was a Rhodes Scholarship finalist, Churchill Scholarship finalist and recipient of the Academic Decathlon Scholarship. His achievements are evident in his recognition as valedictorian, dean's list recipient every semester he attended NC State and being named a Computer Science Faculty Senior Scholar.

Lila Crick, a senior double majoring in aerospace engineering and mathematics, received the Senior Award for Citizenship and Service.

Catherine Wagner, a senior double majoring in chemical engineering and Spanish language and literature, received the Senior Award for the Humanities.

Adithya Balaji, a senior double majoring in electrical engineering and computer engineering, received the Senior Award for Leadership.

The CSC department's other nominees for the awards were Neill Robson for the Senior Award for Citizenship and Service, Lauren Siegel for the Senior Award for the Humanities and Darius McFarland for the Senior Award for Leadership.

HENDERSON WINS BEST PAPER AWARD AT EDM2020

Computer Science Ph.D. student Nathan Henderson and his co-authors Vikram Kumaran, Dr. Wookhee Min, Dr. Bradford Mott,

Ziwei Wu, Dr. Danielle Boulden, Dr. Eric Wiebe and Dr. James Lester from NC State and Trudi Lord, Dr. Frieda Reichsman and Chad Dorsey from the Concord Consortium received the best student paper award at the 13th Educational Data Mining Conference held virtually in July 2020.

The winning paper is "Enhancing Student Competency Models for Game-Based Learning with a Hybrid Stealth Assessment Framework." The abstract follows:

In recent years, game-based learning has shown significant promise for creating engaging and effective learning experiences. Developing models that can predict whether students will struggle with mastering certain concepts could guide adaptive support to assist students with mastering those concepts. Game-based learning environments offer significant potential for unobtrusively assessing student learning without interfering with gameplay through stealth assessment. Prior work on stealth assessment has focused on a single machine learning technique such as dynamic Bayesian networks or long short-term memory networks; however, a single modeling technique often does not guarantee the best predictive performance for all concepts of interest. In this paper, we present a hybrid data-driven approach to stealth assessment for predicting students' mastery of concepts through interactions with a game-based learning environment for introductory genetics. Stealth assessment models utilize students' observed gameplay behaviors using challenge- and session-based features to predict students' learning outcomes on identified concepts. We present single-task and multi-task models for predicting students' mastery of concepts and the results suggest that the hybrid stealth assessment framework outperforms individual models and holds significant potential for predicting student competencies.

It was supported by an NSF grant, Guiding Understanding via Information from Digital Environments (GUIDE).

EDM2020 is a leading international forum for high-quality research that mines datasets to answer educational research questions, including exploring how people learn and how they teach.

Darius McFarland

MCFARLAND RECOGNIZED WITH WMEP SHINING STAR AWARD

Darius McFarland, a 2020 B.S. graduate of the department, was presented with the College of Engineering's Women and Minority Engineering Programs (WMEP) Shining Star Award. The award was presented during the virtual 2020 Annual Engineering Awards Reception on May 6, 2020.

The Shining Star Award is presented to the student(s) who consistently support the programs hosted by the Women and Minority Engineering Program office within NC State's College of Engineering. These students willingly and sincerely give their time and energy to support the mission and goals of WMEP. They can be counted on to help out whenever called upon.

McFarland served as the student coordinator for the Student Advancement and Retention Teams (START) Mentoring Program. START is the College's mentoring program for underrepresented minority engineering first-year students. START aims to create useful partnerships among minority engineering students.

In this role, McFarland coordinated monthly activities, reviewed monthly contact reports and served as the mentor to six first-year students. With a team of around 25 fellow engineering students serving as mentors, he maintained consistent contact with peers while actively engaged in his senior year.

In addition to this college-level award, McFarland also won two Department of Computer Science awards. He received the Computer Science Outstanding Senior Award for Leadership, and was one of four recipients of the Donald Bitzer Creativity Award.

Sathvik Prasad

GRADUATE STUDENT TEAMS UP TO HELP CREATE PEER SUPPORT LINE FOR INDIAN STUDENTS IN THE US

When COVID-19 struck the nation in March 2020, students were faced with new uncertainties and hard decisions. Sathvik Prasad, a Ph.D. student in the Department of Computer Science at NC State, wanted to help his fellow international students. Enter the Embassy of India Student Hub — an initiative to engage Indian students in the U.S. that provides a platform for students to connect, collaborate and converse.

"As a student, I experienced the uncertainty and state of panic among the international student community. During this time of crisis, the leadership team from the India Student Hub came together and built a team of student leaders to help fellow students," said Prasad, who is originally from Mysuru, the cultural capital of Karnataka state in India. "As a student leader, I continue to help the Indian student community in the U.S. during these uncertain times."

The goal of this student-led initiative is to support Indian students in the U.S. with a peer support line that provides accurate and reliable information, aides in finding resources and empowers fellow students to make the best decisions possible. The helpline identifies and connects students with resources at The Embassy of India, the Consulate Generals and the Indian community on a case-by-case basis.

Prasad stays up to date on the latest official government guidelines and as a volunteer for the support line, answers phone calls and responds to emails from students, family members, and others.

"People have questions or concerns about travel, recent policy changes and sometimes they just need a fellow student to talk about their situation. India Student Hub regularly posts student advisories curated towards Indian students in the U.S. As a volunteer, I help interpret the India Student Hub advisories. On a case-by-case basis, I help connect students with the appropriate embassy officials when the query is beyond the scope of the peer support helpline."

As of July, the peer support line has had 11,900+ phone calls, 10,000+ emails/texts and a 97-percent response rate.

"The peer support line is one of many examples of how the student community is stepping up to support others in need. People from all walks of life are impacted by the drastic changes around us. As individuals, we need to support one another during these difficult times to the best of our ability."

Looking ahead into the fall semester, Prasad shares that the team is continuing to monitor the latest guidelines and updating information on its website as it is made available. "By frequently updating our website, we provide valuable information to the student population and continue to be a reliable source of information for the general public during these uncertain times."

Students can contact the peer support helpline via phone or email. For more details on the support line and contact information, visit: **ishubus.com/covid19/peersupport**.

Dr. Justus Robertson

TEAM WINS BEST PAPER AWARD AT AIIDE 2019

Computer science Ph.D. graduate Dr. Justus Robertson and his co-authors Morteza Behrooz, a Ph.D. student at University of California, Santa Cruz, and Dr. Arnav Jhala, associate professor of computer science at NC State, won the best student paper award at the 15th AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment (AIIDE 2019) held in Atlanta, Ga. in Oct. 2019.

The winning paper is "Story Quality as a Matter of Perception: Using Word Embeddings to Estimate Cognitive Interest." The abstract follows:

Storytelling capability is an important tool for intelligent interactive agents for communication with human interactors. Better storytelling capability can enable better interactions between humans and intelligent systems. For developing this skill, it is important to model what makes computationally generated stories interesting to humans. Existing metrics for story quality are either focused on textual features that are not necessarily reflective of perceived interestingness (e.g. coherence) or are domain-specific, relying on a priori semantic models (e.g. in games as templates for action sequences). However, the effectiveness of storytelling depends both on its versatility to adapt to new domains and the perceived interestingness of its generated stories. In this paper, drawing from cognitive science literature, we propose and evaluate a general computational method for estimating cognitive interest in stories based on the level of predictive inference they cause during perception.

AIIDE 2019, sponsored by the Association for the Advancement of Artificial Intelligence (AAAI), brings together researchers and practitioners who work in AI for entertainment, including game designers, creative technologists, and media artists, and academic and industrial AI researchers.

TEAM WINS BEST PAPER AWARD AT AIED 2019

Ph.D. students Guojing Zhou and Markel Sanz Ausin, former postdoctoral researcher and current SAS employee Dr. Hamoon Azizsoltani and professors Dr. Min Chi and Dr. Tiffany Barnes, won the best paper award at the 20th International Conference on Artificial Intelligence in Education (AIED 2019) held in Chicago, Ill. in June 2019.

The winning paper is "Hierarchical Reinforcement Learning for Pedagogical Policy Induction." The abstract follows:

In interactive e-learning environments such as Intelligent Tutoring Systems, there are pedagogical decisions to make at two main levels of granularity: whole problems and single steps. Recent years have seen growing interest in data-driven techniques for such pedagogical decision making, which can dynamically tailor students' learning experiences. Most existing data-driven approaches, however, treat these pedagogical decisions equally, or independently, disregarding the long-term impact that tutor decisions may have across these two levels of granularity. In this paper, we propose and apply an offline, off-policy Gaussian Processes based Hierarchical Reinforcement Learning (HRL) framework to induce a hierarchical pedagogical policy that makes decisions at both problem and step levels. In an empirical classroom study with 180 students, our results show that the HRL policy is significantly more effective than a Deep Q-Network (DQN) induced policy and a random yet reasonable baseline policy.

The theme for the AIED 2019 conference was "Education for All in the XXI Century." ∎

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