EAGLE DRIVE

2020

- Department of Computer Science
Tennessee Tech University

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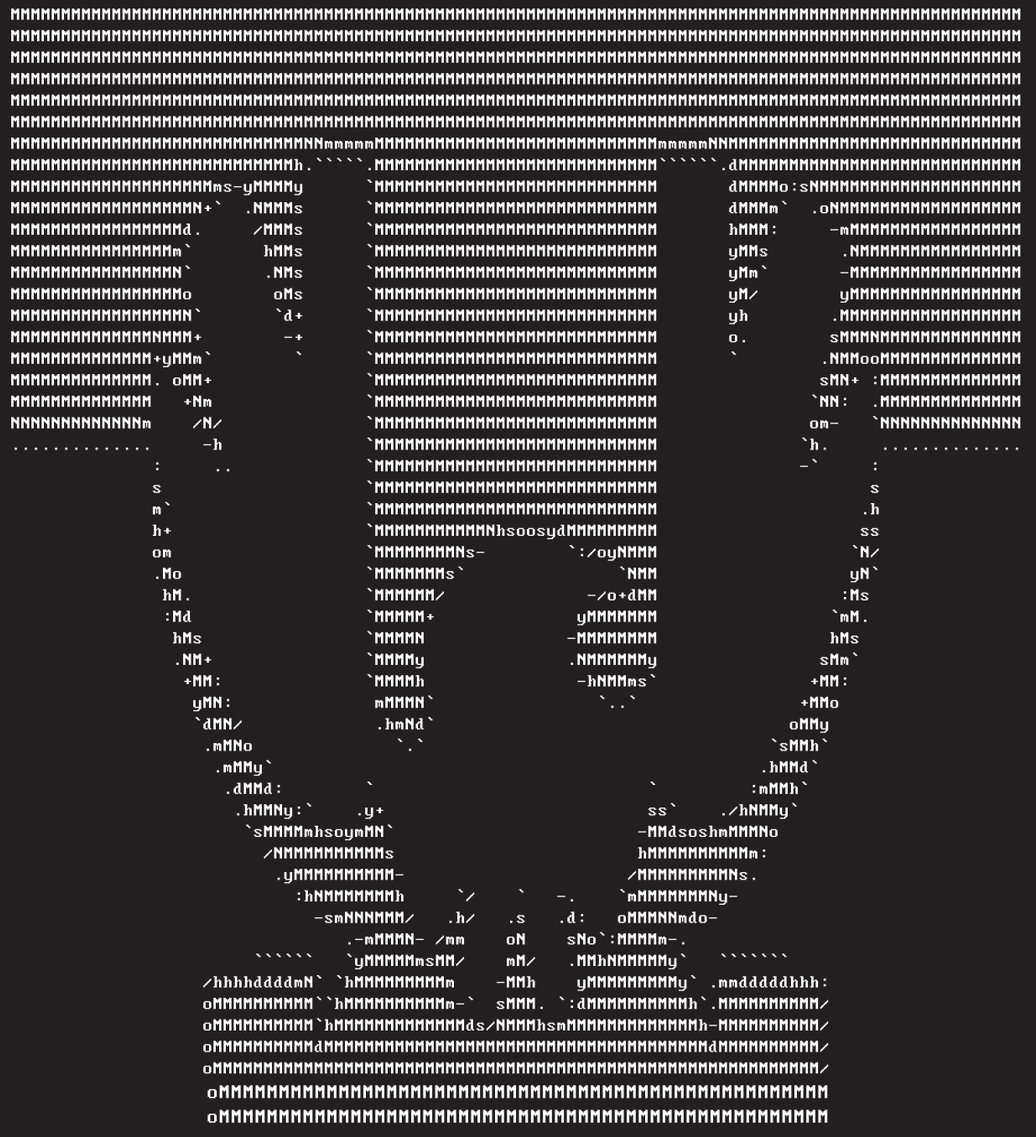

A Word from the Chair

The year 2020 marks the 34th year since the Department of Computer Science was established at Tennessee Tech University and the fourth since I joined as its chair. The year 2020 is also significant in that it was the earmark of a project from the National Academy of Sciences dubbed "The Engineer of 2020: Visions of Engineering in the New Century." The attributes of the "Engineer of 2020" (in which I would include computer scientists) were identified as the following:

- Strong analytical skills
- Practical ingenuity and creativity
- Good communication skills
- Mastery of the principles of business and management
- Lifelong learners
- Leadership, high ethical standards and a strong sense of professionalism
- The dynamism, agility, resilience and flexibility to work in the uncertainty of today's world

As the literal class of 2020 finishes up their degrees, I can proudly say that we as a department have been seeing the fruits of striving to produce exactly the kind of graduates that live up to those standards. We are indeed, very proud of our students and their accomplishments, some of which you will read about in this inaugural issue of the Computer Science: Year in Review.

This year also marks a significant milestone in the Department of Computer Science. Like most computer science programs nationally and internationally, our program has been growing in enrollment to the tune of more than 50 percent combined growth in our undergraduate and graduate programs. We have been blessed with this growth to also see an increase in investment by the university, including the resources needed to add seven new faculty to our department as part of a cluster hire in cybersecurity. This influx of new hiring also included faculty to continue to meet the educational mission of the department through adding full-time lecturers. You will get an opportunity to meet those faculty in the pages that follow.

In this issue, you will also read about awards received by our faculty and students, feature stories on some of our graduates and student groups, as well as highlights that profile some of our alumni. You will also find a special section from the Cybersecurity Education, Research and Outreach Center, including a small insert with tips on how to protect your identity, privacy and computers.

Finally, be on the lookout in this issue for various QR codes and other digital breadcrumbs sprinkled throughout. These serve as virtual rabbit holes for learning more about our past, present and future community of computer scientists. For my part, I am continually thankful to have joined such a great department. The faculty community is welcoming, and the students are clearly amongst the best on campus. The only thing that is missing is you, whether you are a prospective student, an alumnus, an employer or otherwise, we hope that you'll take an opportunity to peruse this issue and connect with us through our virtual guestbook.

Best Regards,
Jerry Gannod

ABOUT THE DEPARTMENT

THE Department of Computer Science was first established in January 1986, by the Tennessee Board of Regents. At that time the unit department was composed of seven faculty members. In 2010, the department moved to the College of Engineering.

The department has experienced record growth in enrollment and degrees conferred, with approximately 580 students spread across bachelor's, master's and Ph.D. programs. Currently, the computer science department has 19 faculty members with research interests, ranging from cybersecurity, machine learning, high-performance computing to software engineering. In Fall 2019, the expansion of faculty members occurred by adding seven new faculty positions. The department was instrumental in establishing the Cybersecurity Education, Research and Outreach Center in 2016 and currently has several faculty members affiliated with the center, with Ambareen Siraj, Ph.D., as its director.

The department's goal is to be widely recognized to enable students to have a global impact through innovation, quality programs and research with collaborative partnerships to improve the success of a diverse community both on campus and off. Our graduates are prepared to compete in the job market and contribute to the economic, scientific and social development of the nation.

New research grant activations in the department have grown in the past five years from less than $500,000 in 2014 to more than $3.3 million in 2019. In December 2018, Rina Singh (currently a postdoc at NYU) became the department's first female to earn a Ph.D. in computer science. The first cohort graduates of NSF SFS Cybercorps students were awarded their degrees in December 2018 and May 2019.

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Awards received in 2019 include:

- **ACM SIGSOFT Distinguished Paper Award to Assistant Professor Akond Rahman for the following paper:** Rahman, A., Parnin, C., and Williams, L. (2019). The Seven Sins: Security Smells in Infrastructure as Code Scripts. In proceedings of the 2019 IEEE/ACM 41st International Conference on Software Engineering (ICSE).

- **Institute on Aging 2019 Innovation Research on Aging Awards (Silver) awarded to department Chair Gerald C. Gannod and colleagues for the following paper:** Gerald C. Gannod, Katherine M. Abbott, Kimberly Van Haitsma, Nathan Martindale, Alexandra Heppner (2019), A Machine Learning Recommender System to Tailor Preference Assessments to Enhance Person-Centered Care Among Nursing Home Residents, The Gerontologist, 59(1), Pages 167–176, https://doi.org/10.1093/geront/gny056

FOCUS ON THE NEW FACULTY
Computer Science Adds Seven New Faculty

Akond Rahman Assistant Professor

Akond Rahman was drawn to Tennessee Tech by the opportunity to grow and the collegiality of the faculty. He is researching development and operations (devops) and software security and cataloging various activities that ethical hackers pursue to exploit vulnerabilities. His favorite thing about the university is the students, and he enjoys serving as a mentor to both undergraduate and graduate students. The biggest challenge he has faced in his career was transitioning from a non-computer science background to a computer science-based curriculum during the early years of his undergraduate studies.

Rahman holds a doctorate in computer science from North Carolina State University, a master's from the University of Connecticut and a bachelor's from Bangladesh University of Engineering Technology. He is the recipient of the 2019 ACM SIGSOFT Distinguished Paper Award, 2018 ACM SIGSOFT Best Doctoral Symposium Paper Award and the 2016 Microsoft Open Source Challenge Award.

"This is a great area that allows a student to fulfill his or her full potential for a STEM-based career," Rahman said as advice for students considering a career in computer science. Software developer, data scientist, software tester, cybersecurity analyst, network engineer, site reliability engineer or devops engineer are among the many careers he suggests for students majoring in computer science. including software developer, data scientist, software tester, cybersecurity analyst, network engineer, site reliability engineer or devops engineer.

Muhammad Ismail Assistant Professor

Prior to coming to Tennessee Tech, Muhammad Ismail worked for six years as a research scientist at the Texas A&M University branch campus at Qatar. His current research field is planning, operation and cyber-physical security in smart grids and wireless networks. He is interested in the application of deep machine learning in resource management and cyber-security of smart grids and wireless networks.

"I had a successful history of joint research projects with Tennessee Tech over the past five years with total funding of $1.3 million," Ismail said. "Over these five years, I got to know how ambitious and professional Tennessee Tech is. When I knew there was an opening at Tennessee Tech, I did not hesitate to apply and join such an ambitious place."

Ismail is also passionate about teaching difficult concepts in simpler ways. However, he is challenged by finding good students for his doctoral program.

"Never lose passion to learn more. This is a very dynamic field, and you should always be up to date," Ismail said as advice to students in computer science.

Ismail holds a doctorate in electrical and computer engineering from the University of Waterloo in Canada. He is also the recipient of the 2019 Paper Award from the IEEE Technical Committee in Green Communications and Networking in the IEEE International Conference on Communications, the Research Fellow Excellence Award from Texas A&M University at Qatar in 2019, the Best Paper Award in GREEN 2016 and the Best Paper Award in SGRE 2015.

Susmit Shannigrahi Assistant Professor

One of the more recent additions to the computer science department, Susmit Shannigrahi chose to come to Tennessee Tech because of its recent growth and upward trajectory. His research area is computer networking, and he is exploring how to create new network protocols to help scientists move and manage large amounts of data. His favorite things about Tech are the students, faculty and the friendly community.

To students considering computer science, Shannigrahi offered this advice: "Your imagination is your only limitation. You can major in computer science, and you will find that you can apply your skills to a huge number of fields. You can learn to code well. Pay attention to fundamentals - data structures, algorithms and systems."

Shannigrahi holds a doctorate in computer science from Colorado State University.

Travis Brummett Lecturer

A native of Kentucky, Travis Brummett joined the faculty at Tennessee Tech in Fall 2019. His primary research area is cloud computing, and recently he has been exploring serverless architectures and using a meta-modeling system to deploy an entity component system simulation across a distributed system. Brummett is enthusiastic about the opportunities to teach both in and out of the classroom. He looks forward to the various clubs and activities the computer science department offers. New to teaching, he has faced some challenges, but he loves working with students and helping them learn.

"For me the biggest challenge has been figuring out what works best for the students and what doesn't," Brummett said. "I'm still trying to find the best combination of class activities to ensure they learn the most they can. I am also a nervous and shy person by nature, so teaching larger sections of a course is something that I have to adapt to and work on."

Brummett received his master's in computer science from Vanderbilt University as well as a master's and a bachelor's in computer science from Western Kentucky University. He has also served as a graduate assistant in the computer science departments at Vanderbilt and Western Kentucky. He received the 2012-2013 ACM Outstanding Student Award from the computer science department at Western Kentucky.

Rachel Ania Kaczka Jennings Lecturer

As a graduate student pursing a doctorate in computer science at Tennessee Tech, Rachel Jennings discovered she enjoyed engaging with the students as a teacher assistant. It is rewarding for her to see students understand difficult course material and topics. Jennings' favorite part about Tech is the community in Cookeville. She loves how it rallies around the university, its students and each other. Her biggest challenge is time management and handling the responsibilities that come with a large course load, such as grading, preparing course material and administrative tasks.

"Don't be afraid to fail," Jennings said as advice to students considering computer science. "Part of computer science and programming is failing and learning from failure. Taking time to understand a concept or failing the first, or several times, does not mean you can't be a computer scientist or programmer."

Jennings received her bachelor's and master's in computer science from Miami University in Ohio.

Maanak Gupta Assistant Professor

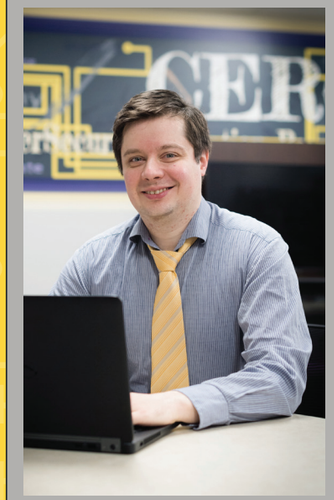
One of the newest computer science faculty members at Tennessee Tech, Maanak Gupta has many research projects underway in the areas of foundational aspects of authorization, machine learning, and artificial intelligence driven security solutions.

"Engagement with students, listening to them, their novel ideas and ingenuity has been my favorite part," Gupta said. "I enjoy both teaching and research; research that has real impact. This profession allows me to serve society and have societal contribution, for example by organizing trainings and boot camps in cyber training. This is really important and inspiring to me."

To students considering a career in computer science, Gupta offers some advice, "Computer science is the future, and the demand will always be increasing. Either you talk about cybersecurity, data science, machine learning or artificial intelligence. Tech has a great computer science program which is Accreditation Board for Engineering and Technology accredited and provides a breadth and depth of a broad set of courses. It has a very good reputation with the employers also which will help you get a good job and start a great career."

Gupta holds a doctorate and master's in computer science from the University of Texas at San Antonio, a master's in information systems from Northeastern University and a bachelor's in computer engineering from Kurukshetra University in India. He has received several awards including the 2019 UTSA Outstanding Doctoral Dissertation Research Award in Computer Science and the 2018 UTSA Three-Minute Thesis Competition Finalist.

Denis Ulybyshev Assistant Professor



From an early age, Denis Ulybyshev was interested in mathematics, informatics and computers. Later, he became interested in exploring novel technologies and methodologies in computer science and software engineering. He was drawn to Tennessee Tech because of similar research interests, as well as the professional and friendly environment in the department.

"I enjoy the opportunity to do research that helps the community and is demanded by industry," Ulybyshev said. "I also enjoy the opportunity to help students with their future careers. Once I started working as an assistant professor at Tennessee Tech, I found that teaching courses takes more time than expected. Speaking about the research, it is not easy to bring valuable novelty to the field."

Ulybyshev researches cybersecurity, data science and blockchain-based technologies. His current project aims to help small healthcare businesses with a HIPAA-compliant and novel software solution for secure storage and transfer of electronic health records.

Ulybyshev holds a doctorate and master's in computer science from Purdue University, as well as a master's in automatic control systems from Bauman Moscow State Technical University. He is the recipient of the Harris Teaching Award for Supporting Women in Computer Science, the CERIAS 2019 Diamond Award for Outstanding Academic Achievement, the ACM Mid-Southeast Best Paper Award, the Purdue Computer Science Corporate Partners Award, the Best Poster Award at 16th CERIAS Information Security Symposium and the Second-Best Poster Award at 20th CERIAS Information Security Symposium.

ALUMNI HIGHLIGHTS

Ms. Mary Patterson graduated from Tennessee Tech University in 1968 with a bachelor's degree in mathematics. When she attended Tennessee Tech, no degree program in computer science existed. During her senior year, she took IBM's programming aptitude test, and her extremely high scores ultimately led to a successful long-term career with IBM. She believes that her education at Tennessee Tech has contributed to her success; thus, she decided to endow a scholarship as a way to give back to the University. The primary purpose of this scholarship is to encourage female and minority students to pursue studies in computer science. The award is $2,000, which will be disbursed in two $1,000 installments to pay for tuition expenses during the fall and spring semesters.

PAPER AWARDS

Professor Ambareen Siraj

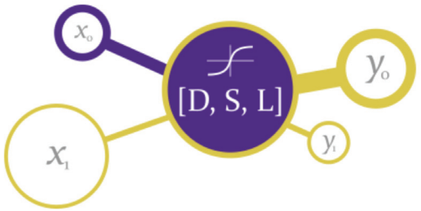
Anshu Bhattarai

Anshu Bhattarai and Professor Ambareen Siraj recently received the best paper certificate in regular research paper type for the artificial intelligence and machine learning track for their collaborative piece, **"Increasing Accuracy of Hand-Motion Based Continuous Authentication Systems"** at the 9th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference.

- **Md Bulbul Sharif** and **Professor Sheikh Ghafoor** recently presented a system for "**Performance Porting of Iterative Structured Grid Applications in HPC Environments"** at the 21st International Conference of Computer and Information Technology in 2018.
- Plos.org published an article co-authored by **Professor Mohammad Alam**. The article is titled "**A priority-based energy harvesting scheme for charging embedded sensor nodes in wireless body area networks."** To read the full article, visit **journals.plos.org/plosone**
- **Professor Denis Ulybyshev's research group** won a best paper award at ACM Mid-Southeast 2019 with the project **"Secure Container for Data Protection in Transit and at Rest."** Ulybyshev noted, "I am happy to achieve this result with a very diverse team that includes domestic and international students, graduates and undergraduates, a female student and a student with special needs."

STUDENT GROUPS

CYBER EAGLES
Tennessee Tech University
We soar to defend



ACM TTU

CyberEagles

The purpose of the CyberEagles Security Club is to increase awareness about the importance of security and security careers while offering learning opportunities for students in cyber offense and defense techniques and tools. The club also promotes research in security, as well as helps members network with peers and security professionals. Membership into CyberEagles is open to any Tech students, faculty, staff or alumni.

Data Science League

In the today's world, the respective fields of data science and machine learning are growing more important. It's increasingly critical for people from all walks of life, particularly anyone involved with computer science, to be aware of and have a basic understanding within these fields. Data science is a concentration within the computer science degree program. The aim of the Data Science League is to fill that hole – to promote the discussion of artificial intelligence, machine learning and data science.

ACM

The Tech student chapter of the Association for Computer Machinery exists to promote the exploration of computer technology. The chapter accomplishes this by conducting workshops, bringing guest speakers to campus, as well as providing social events for its members.

Graduate Student Club

The Computer Science Graduate Student Club is open to all computer science graduate students. The club's main event is the Computer Science Graduate Seminar Series. Every couple of weeks, a current graduate student in the department will present their current research topic or on a topic that interests them. This series is open to anyone to listen and ask questions. The main goal of the presentations is to allow other students to see and hear what their peers are working on and to promote research collaboration, initiate discussion and generate new ideas. Beyond the seminars, the club also has a potluck picnic every semester to allow the students to show off their cooking skills, to enjoy food from other students' native countries and to interact with each other in an informal setting.

STUDENT HIGHLIGHTS

Mateo Gannod accepts one of the ChaTech Scholars Awards.

Anthrony Taylor and Kalen Berry place second in the Eagle Works competition for their live marketplace invention.

- Our first cohort of NSF Cybercorps Scholarship for Service students completed degrees in Fall 2018 and Spring 2019.

- Two teams from Tech competed at our local site of the Mid-Central Regional of the ACM International Collegiate Programming Contest. Fourteen teams competed at our site, including teams from Vanderbilt University, Lipscomb University, Maryville College, Belmont University, and University of North Alabama. The students worked tirelessly for five intense hours to complete as many of the 11 programming problems as they could. The top two teams at our local site were two teams from Vanderbilt. The first-place team solved six of the 11 problems and placed 11th in the entire region, and the second-place team solved five of the problems to place 25th in the region. Tech's Team Rocket, consisting of students Kirill Kozlov, John Simmons and Alec West, solved four of the 11 problems to place sixth locally and ahead of approximately 70 teams in the region. TTU Team 2, consisting of students Jeff Neikirk, Brendan Roberts, and Jordan Johnson, solved three of the 11 problems to finish eighth locally. For more information on the competition, you can visit mcpc18.kattis.com/ and icpc-midcentral.us/.

- Mateo Gannod has been selected to receive one of ChaTech Scholars Awards. ChaTech is proud to have a robust scholarship program to support their strategic goal to invest in the region's technology talent. This scholarship program is open to students enrolled in an information technology major and awards range from $1,000 to $2,500.

- Katie Brown won a Best Paper Runner-up Award at the 2019 ACM Southeast Conference. The title of her paper was "Heuristically Reducing the Cost of Correlation-Based Feature Selection." Its feature selection encompasses the algorithms techniques that reduce the number of features a machine learning algorithm processes and is a critical aspect of the data science pipeline. The paper presented the development and creation of two new algorithms that decompose an exponential feature selection algorithm so that it runs faster with minimal losses in accuracy.

- In the Eagle Works competition held in April 2019, two Tech students placed second for entrepreneurship. Anthony Taylor, computer science, and Kalen Berry, mechanical engineering, presented "Trade 'Em," a live marketplace for buying, selling and trading sneakers and streetwear.

Photo: Jeff Sabo – Miami University

THE FUTURE OF HEALTHCARE

What Tech faculty and students are doing to help improve caregiving

America's population is aging at a rapid pace, and technology can make caregiving more efficient.

The multi-university development between Tennessee Tech, Miami University in Oxford, Ohio, and Penn State University was named one of three recipients of the Innovative Research on Aging Silver Award.

"It's part of a larger effort to identify and meet preferences for residents in nursing homes," Jerry Gannod said, chair of Tech's computer science department and the project's lead investigator, along with Katy Abbott and Jane Straker of Miami University and Kimberly Van Haitsma of Penn State University. "Just because people have aged and moved into a nursing home, doesn't mean their preferences have stayed the same."

This project focuses on person-centered care in skilled nursing communities. Specifically, it seeks to improve upon the Preferences for Everyday Living Inventory (PELI-NH), which is commonly used in nursing homes.

"There are 72 questions in the PELI-NH survey," Gannod said. "This software would reduce that to 16 questions that direct care workers can ask of residents while the software helps identify preferences without having to ask the other questions."

It's similar to what Amazon or Netflix does with recommendations using machine learning technologies, such as "If you enjoyed X, you might also enjoy Y."

The development team found that the recommender system was extremely accurate at predicting important preferences of residents with an 80.2 percent recall performance — the ratio of correctly predicted preferences compared with all predicted preferences and non-preferences — and a 79.2 precision rate in correctly predicted rules with respect to the rules predicted to be true.

"Because the recommender uses data from other residents to predict preferences, the algorithm will become more accurate as larger datasets become available," the developer team concluded. "Ultimately, the use of machine learning could assist nursing home providers in tailoring their preferences assessments to maximize staff time while minimizing the burden of asking a resident dozens of questions."

Tennessee Tech computer science graduate student Nathan Martindale did much of the software development.

"We met with other investigators weekly," Gannod said. "There have been a number of graduate students who worked on this as well. It's been a great team."

The project has been in development since a 2016 grant from the Ohio Department of Medicare was awarded and was published in the May 2018 edition of The Gerontologist.

The development team was awarded $1,000 from the Institute on Aging. The study, along with seven other studies, is featured in a brief report that can be seen here: matherlifewaysinstituteonaging.com/researchers/innovative-research-award/.

Gannod is trying to identify partner nursing homes with this software and is also working with a company located in Washington, D.C., to license the software.

"The gerontology field has not seen anything like this," Gannod said. "It's efficient, personalized and can improve the quality of care in nursing homes."

Growth In Computer Science

Loading...

THE university's fastest growing department and the second largest in the College of Engineering is keeping up with the national demand by a cluster hire of new faculty members: Denis Ulybyshev, Maanak Gupta, Muhammad Ismail, Akond Rahman, Susmit Shannigrahi and Travis Brummet.

"The cluster hire features cybersecurity, networking and software engineering experts," department Chair Jerry Gannod said. "All of this is to help us improve the curriculum, offer new courses and handle the influx of new students coming in." Generally, the field is partitioned into a number of different subfields, including systems, software, theory and application. "In the department of computer science, we teach a core undergraduate program in computer science, as well as concentrations in cybersecurity, data science and high-performance computing," Gannod said.

The new faculty members are excited about Tech's research capabilities.

"There are a lot of opportunities to do research," new faculty member Denis Ulybyshev said. "There's a good balance between research and teaching."

The growth of Tech's program reflects a national trend. "That's due to the creation of jobs," Gannod said. "There's a shortage in cybersecurity employees, a shortage in software developers; it is how our society has evolved. Everyone walks around with a powerful computer in their pockets. There's a need to have employees and developers who can meet those needs and develop those new technologies."

Gannod took over as chair of the department in July 2016. Since then, he has seen a lot of growth.

"At that time, there were a little more than 360 to 370 students," he said. "This year, I expect us to be pushing close to 600 students in the program."

New faculty members in the department are looking forward to being part of this growth.

"I'm looking forward to motivating highly intelligent students," Maanak Gupta said.

Tech's program is unique in that graduates are ready to hit the ground running for employees after the completion of the program.

"The computer science program here at Tennessee Tech has long been recognized as being able to produce graduates that are ready to work from nearly day one," Gannod said. "The president often talks about our students being shovel ready and career ready. I think that our department and graduates are a clear embodiment of that ideal. Our students are known by employers as ready to work. We have a local employer that said it takes typically four to six months for graduates to be ready to be fully contribute to the work projects. But our students are ready in four to six weeks, which says a lot about our students and graduates. As the shepherds of the students coming in, it's about us shaping them, helping them to develop and get ready for the work force."

Making History: First Female Ph.D. Graduate in Computer Science

Rina Singh

When Rina Singh walked the line with other graduates, she made history as Tennessee Tech's first female — and the university's third student — to receive a doctorate in engineering with a concentration in computer science.

Singh has come a long way since her humble beginnings in the small village of Bishwambharpur, Nepal.

"I grew up in a mud house without electricity or running water," she said. "I spent my days playing in the rivers and ponds of the village, climbing trees in my family's mango grove and helping my mother with the household chores."

It was her oldest brother who influenced her decision to pursue higher education. He was attending college in Kathmandu, Nepal's capital city, and would visit family during his winter vacations. Singh would ask him questions about what he learned while at school and what life was like in the big city.

Listening to his experiences encouraged her to get her degree. But she had some hurdles to overcome.

"Life in the village was hard," she said. "Girls rarely left to pursue a college education."

With her brother's help, they convinced her parents to break with the village's traditions and send her to Kathmandu to begin the 8th grade. She was 13 at the time.

"I was originally denied admittance into the 8th grade in Kathmandu because my village school did not offer any computer courses," she said.

Following completion of her secondary education, Singh was accepted into the Nepal College of Information Technology in Kathmandu and was awarded a bachelor's degree in software engineering in 2006. After receiving her bachelor's, she worked as a software engineer and research assistant in the city.

"My uncle, Dhanpat Patel, inspired me to return to school and complete a doctoral program," she said. "He inspired me to pursue a higher degree, but I was never really focused on getting a degree from the United States."

In 2009, Rina was accepted into Delft University of Technology's computer science program in the Netherlands. She received her master's degree from that university in 2012. While searching for doctoral programs, she moved to China and began work as a research assistant, and in January 2014, she was accepted into Tech's graduate program.

> "I'm very excited to be the first female Ph.D. computer science graduate here at Tennessee Tech," Singh said. "This program is very competitive and welcoming. There's such a friendly environment and a great support system here."

Her accomplishments also make her the first female in her family to go to college and earn a Ph.D.

Doug Talbert, associate professor of computer science, was her doctoral advisor.

"I helped her plan her course of study and helped her shape her research direction," he said. "We typically met once or twice a week to discuss how things were going and discussed next steps. I also provided feedback and suggestions to help her develop an ability to do independent research."

Singh's area of expertise is data mining and machine learning.

"She has worked in sequential pattern mining, finding meaningful and useful patterns in data represented as sequences, and deep learning, the use of large artificial neural networks to discover and make use of very complex patterns in data," Talbert explained.

Part of her research involved working with a colleague of Talbert's from the University of Kansas Medical Center to acquire and use some data related to the care of sepsis patients by looking at the sequences of orders that were written on such patients.

They also enlisted the help of the faculty in Tech's Whitson–Hester School of Nursing.

"Nursing Professor Susan Piras, helped us understand the general process of sepsis care and helped us understand our data well enough to use it to help Rina validate the algorithms she developed," Talbert said. "To date, Rina's research has primarily focused on advancing the state-of-the-art in computer science."

They had a long conversation with Talbert's colleague at the University of Kansas medical center to begin the work of applying her algorithms to actually better understand and hopefully improve patient care.

Computer science is the study of the theories and applications of computers. There are a number of different subfields, including systems software, theory and applications.

The computer science program is starting to take off. The number of undergraduate students enrolled in 2012-2013 stood at 341. Fifteen students were in the graduate program.

During the 2017-2018 fiscal year, 433 undergraduates were enrolled. Forty were enrolled in the graduate program. The 2018-2019 year shows that 485 students are enrolled in the undergraduate program while 54 students are enrolled in the graduate program.

Graduates go on to work in traditional mainstream computing companies and financial, healthcare, entertainment and government sectors.

"I'm very excited to be the first female Ph.D. computer science graduate here at Tennessee Tech," Singh said. "This program is very competitive and welcoming. There's such a friendly environment and a great support system here."

What Lies Ahead for Cybersecurity

CEROC

When Ambareen Siraj came to Tennessee Tech in 2006, she was asked to teach a security course in computer science. That elective course had six students enrolled in it.

Twelve years later, that security course has blossomed into one of the top cybersecurity programs in the nation with Siraj one of the foremost experts in cybersecurity curriculum and instruction.

"Dr. Ambareen Siraj has long been a leader in the department and in the cybersecurity education community," Jerry Gannod, chair of Tech's department of computer science, said. "Her continued success has led to a growing interest in Tennessee Tech and the department of computer science as a destination for cybersecurity education. We are extremely proud of her accomplishments and the value she brings to our students in the classroom, research laboratory and in her support for extra-curricular activities."

Besides that security course, Siraj added other security-type courses to the computer science curriculum over the years. With cybersecurity becoming a global concern requiring the utmost attention from all sectors of government and industry, there became a growing need for skilled professionals regionally, nationally and globally.

"Our nation is in dire need of cybersecurity professionals at all levels and roles," Siraj said. "It is our honor and privilege at Tennessee Tech to prepare students to serve the nation with this unique skill."

Tech capitalized on those needs in 2015 by offering a cybersecurity concentration to undergraduate students. The program was so good that the National Security Agency and the United States Department of Homeland Security designated Tech as a Center of Academic Excellence in Cyber Defense. Graduates receiving their degree in this concentration will have a seal of certification from the NSA and DHS agencies on their diplomas.

Siraj then took the program a step further by creating the Tennessee Tech Cybersecurity Education, Research and Outreach Center (CEROC). The center was established in an effort to integrate university-wide existing activities and initiatives in cybersecurity education, research and outreach. Tech's CEROC is also unique because it is the only center in Tennessee which emphasized integration of education, research and outreach.

"Cybersecurity has existed to a certain degree, but not in the form that it is now," CEROC assistant director Eric Brown said. "The biggest change that brought it into the limelight is when society changed. Everybody started carrying a smart phone — a mini computer in their hand. We provide quality cybersecurity education, which is one of the essential skill sets for the 21st century."

Tech's Cybersecurity Education, Research and Outreach Center received a big boost in 2016 when it received a grant from the National Science Foundation for nearly $4 million to establish the Tennessee CyberCorps: Scholarship for Service program. The grant, which runs through July 31, 2021, provides students with full coverage of tuition, health insurance reimbursement, professional and development travel, money for books and an additional stipend for both undergraduate and graduate students.

"This makes Tech one of the highly visible cyber defense education programs in the country," Siraj said. "Many strides are being taken to improve our cybersecurity program at Tennessee Tech to produce prepared students ready for the cybersecurity workforce."

Over the years, Brown has seen the program mature and expand exponentially. "We have been in a state of explosive growth really since the beginning of the center, every year we have expanded in a different area," Brown said, "and that's kind of the nature of cyber right now."

There are many positions within the field of cybersecurity that are waiting to be filled. Within CEROC the focus is on not only the current student's success but also a variety of outreach programs involving potential students. There is a community of current computer science students and mentors always looking for more members to join their efforts in bringing cybersecurity awareness to others.

"We have some incredible students that are just making things happen," Brown said.

The first CyberCorps class consisted of four students who have gone on to secure positions with government federal, state, local, tribal or national labs in cybersecurity.

Besides just training Tech's students, Siraj started a CyberCorps Scholarship for Service BootCamp to help other CyberCorps students. Students from schools all around the country come to Tech for two days to be trained in a variety of research and related soft skills to help them be successful in their cybersecurity education journey. Skills training includes communication and technical writing skills, ethics, etiquette, time management, personal finance, service learning, federal resume writing, and even dining etiquette. Participants of the camp also have an opportunity to hear and interact with speakers from a variety of local and federal agencies, gaining insight into thecybersecurity needs at the federal level.

"It's an awesome opportunity for these students to get viewpoints from professionals in the field ranging from government agencies, industry and academia to fully understand this great new world they are going into in their cybersecurity career," Brown said.

Tech's cybersecurity outreach touches middle school and high school students, teachers and guidance counselors, too. Tech hosts a GenCyber Combination Camp every summer that incorporates basic cybersecurity concepts through hands-on exercises and games involving technology, as well as opportunities for collaboration and group work. The goal of the camp is to increase cybersecurity awareness and interest while helping all students understand correct and safe online behavior.

"It's an opportunity to introduce cyber to these students and show them all the things cyber can be," Brown said. "It's education and law enforcement and communications. There are a lot of moving pieces, and we want to show these students the many facets there are to cybersecurity."

Tech's cybersecurity program continues to expand. Siraj founded the Women in Cybersecurity (WiCyS) national conference which has grown every year.

CEROC also joined the Department of Homeland Security's STOP. THINK. CONNECT. Campaign. This national public awareness campaign aims to increase the understanding of cyber threats and empower the American public to be safer and more secure online.

There are now more than 150 undergraduates majoring in cybersecurity and several more students working on a master's or doctorate in cybersecurity.

> "We have some incredible students that are just making things happen,"

What was once an elective security class of six students, has grown into a thriving program that is becoming well-known throughout the nation. While Siraj has been a huge part of Tech's success, she is quick to give credit to the students who comprise the program.

"What makes us so unique and special is our student body," Siraj said. "I've seen students from other schools. I really love our students. They are so humble and hard-working. They know the sacrifices their parents make to put them through school. They are very dedicated. Whatever we are doing in CEROC and computer science is because our students are so great."

Improving Our National Security with AI

Lynne Parker

Artificial intelligence is the wave of the future, and one Tennessee Tech alumna is leading the effort.

Lynne E. Parker, a 1983 computer science graduate, was appointed to the position of assistant director for artificial intelligence of the Office of Science and Technology Policy in August 2018 by President Donald Trump's administration. In November 2019, she was also appointed to the position of Deputy Chief Technology Officer.

"Computer science has always been a rapidly changing field, and its pace of change continues to accelerate," Parker said. "That's one of the things I love about the field because there is no chance to get bored. You have to continuously read and study to keep up-to-date with the latest advances in the field."

Regarding AI development, President Trump stressed the importance of investing in the cutting-edge industries of the future.

"AI technologies are transforming nearly every area of our lives, from transportation to healthcare to education to security," Trump said. "Even now at the earliest stages of commercializing these technologies, we have seen the power and potential of AI to support workers, diagnose diseases and improve our national security."

When Parker first began her studies in computer science, there were very few open source tools or helpful user interfaces that allowed someone to create new solutions quickly.

"Instead, we had to build everything ourselves, sometimes even writing assembly code (very low-level programming language) for the most basic of functions," she said. "Now, it's terrific that we have so many sharable tools and libraries that can help us create solutions to new problems much more quickly."

Her education at Tech gave her a good start in her future studies.

"My bachelor's studies at Tennessee Tech provided me an excellent foundation in computer science that served me well as I went on to future studies at UT Knoxville (for my master's degree) and MIT (for my Ph.D.)," she said. "Perhaps more importantly, the strong sense of community across the Tech campus influenced my belief in the importance of being a leader and giving back to the broader community, whether it be through campus activities, professional service roles or national leadership positions. I find great satisfaction in being able to use my expertise to serve the greater good."

Prior to being appointed to the OSTP, she worked in Oak Ridge National Laboratory, founded the Center for Intelligent Systems and Machine Learning at the University of Tennessee in Knoxville and was the interim dean of the Tickle College of Engineering at UT Knoxville.

"I've had the good fortune of building up a strong career in AI and robotics both at Oak Ridge National Laboratory and the University of Tennessee, Knoxville," she said. "Besides the research and educational activities that are at the core of a research and academic career, I have also always held a deep belief in the importance of using my expertise to serve the broader AI and robotics community."

In 2015-2016, she accepted the offer to serve as division director of information and intelligent systems at the National Science Foundation.

"In that role, I engaged in a variety of interagency coordination and leadership activities across the federal agencies, including serving as the co-chair of the interagency task force that created the National AI R&D Strategic Plan," she said.

Those successful efforts are what got her the position at the White House OSTP.

"My own research expertise is in using AI to build intelligent mobile robot teams, as well as robot teams that work naturally with humans," she said. "In recent years, my students and I have been developing methods for robots to use their sensors to better understand the activities and actions of human teammates and then contribute naturally to the human's task without requiring extra work or attention from the human."

"Even now at the earliest stages of commercializing these technologies, we have seen the power and potential of AI to support workers, diagnose diseases and improve our national security."

The OSTP's activities are aimed at removing barriers to innovations in those applications so all Americans can benefit. "At the same time, we also work to ensure that these AI technologies are used in a way that respects everyone's privacy and civil liberties and are consistent with our American values."

The president's initiative defines a holistic approach to the activities that are needed across the federal government to accelerate the nation's leadership in AI.

"Both current and future workforce challenges are addressed by the initiative, which directs the creation of opportunities for everyone to receive AI-relevant training for both current jobs and jobs of the future," she said. "And to ensure our nation continues innovations for the future of AI, the initiative places a strong emphasis on AI R&D and the infrastructure to support it."

She also said the initiative recognizes that the federal government cannot — and should not — conduct these AI activities on its own, but calls for strong partnerships between the private sector, academia, non-profits and likeminded international allies to make sure the AI is developed and used for the benefit of the American people.

COMPUTER SCIENCE INSTRUCTOR PROVIDES VISUALS FOR VISUALLY-IMPAIRED

April Crockett's lesson plans in her computer science classes at Tennessee Tech have always included plenty of visual and dynamic examples. When two visually-impaired computer science majors began taking her classes, though, Crockett looked to enhance her lesson plans. Now, she is creating visuals for the visually-impaired.

"I have never had visually-impaired students before," said Crockett, a Tennessee Tech alumna who earned a bachelor's in computer science in 2001 and a master's in computer science in 2004. "Last semester, I had two visually-impaired students in Data Structures, and I had to figure out how to demonstrate visual, dynamic content to a student who is blind."

Vadim Kholodilo, a freshman exchange student from Russia, and Carlos Medrano, a sophomore from Nashville, have become regulars in Crockett's classes. With the help of Tech's Accessible Education Center, Crockett uses tactile diagrams with braille to make her drawings and animations visible for Kholodilo and Medrano.

"She gives us problems to solve that really improve our computer science skills," said Kholodilo. "It is definetly super helpful."

"This is my third class I've had with her," said Medrano about Crockett. "Her classes are really organized. Everything, in a sense, is understandable. She is really helpful, and I don't have any issues as far as accessibility goes."

Crockett says that working with Tech's Accessible Education Center has really helped her create work that has been beneficial for Kholodilo and Medrano. She sends the diagrams to the AEC and they prepare them for her class in a timely manner.

"I appreciate them so much. They work so hard," said Crockett about the AEC. "The most difficult thing for me is to complete things in enough time to give them enough time to print out the diagrams to give to Vadim and Carlos in time for class."

Once Kholodilo and Medrano have the diagrams, they are able to see what everyone else in the class can see.

"There was a diagram that I created for Carlos. It was a flow chart diagram," Crockett recalled. "He came up to me

and he was feeling the diagram with his fingers. He said 'I've always known what a flowchart was, but I've never been able to picture it in my mind.' For him to be able to understand and see it in his mind, was a cool moment. I realized then what I was doing was really helping someone."

Crockett admits that creating the tactile diagrams for Kholodilo and Medrano has been a work in progress. But, it has also helped her relationship with her students.

"Because we have met quite a bit so that I can improve the diagrams, I have gotten to know them quite well," said Crockett. "I have really enjoyed that part of it. I've enjoyed getting to know my students. We have a closer relationship because of this."

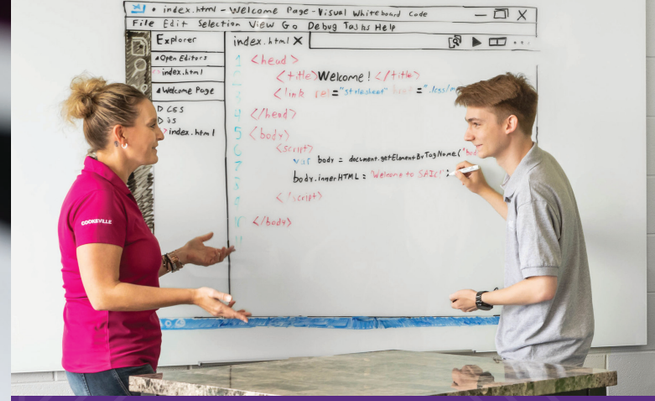
Kholodilo and Medrano enjoy their relationship with Crockett and other faculty on campus. They both realize the challenges of being visually-impaired but have found Tennessee Tech to be very accommodating to their needs.

"If you need something, you can always let instructors know and they will help you," said Kholodilo. "Ms. Crockett and a lot of the professors here at Tech really know what they are doing. They give us materials that are not out of date. They definitely have fresh material for the students. When you study something, they know how to apply it."

"I have heard so many horror stories from students at different universities where students don't have that much accessibility," Medrano explained. "That hasn't been the case here. The professors have been really helpful and accommodating, and I really appreciate that."

Being able to accommodate the visually-impaired students in her classes has also helped Crockett as an instructor.

"They have made me a better teacher. It's always difficult to put yourself in someone else's shoes and figure out how they learn. Even someone without disabilities," said Crockett. "Everyone learns differently. I have learned to approach topics from a different perspective. I've learned how to teach from those perspectives."



TENNESSEE TECH & SAIC

Working Together to Build the Future

Driven by a desire to make a difference in national and global security, SAIC incorporates the skills and abilities from their integrators, collaborators and problem-solvers to help build the best future for security. As a leader in premier technology, SAIC helps solve the nation's most complex challenges across the defense, space, federal civilian and intelligence markets.

"In Cookeville, the number one thing we do that sets us apart is we have software as a service. We have other delivery centers around the country, but this is the first technology gateway center for SAIC. This is the only one where we have software, most of our others are just user services. We offer software, cyber, networking, security and end-user services at this site," said Jill Patrick, software engineer senior manager at SAIC.

The Cookeville location of SAIC currently employs 171 people with 56 being Tennessee Tech undergraduate alumni and three Tech alumni with master's degrees. The full-time employees have degrees ranging from computer science to business.

"The fact that I got offered a job in Cookeville [at SAIC] was a blessing. They were super friendly and super helpful. They are doing what I want to do — agile development," said Tech alumnus Michael Faircloth.

With many locations across the world, having SAIC in Cookeville brings a multitude of benefits for more than just its employees.

"There's a high quality of life here, which is a huge plus. At SAIC, they're going to have opportunities only really presented to people who work for bigger corporations. We are a community partner. It's a great opportunity because most of the businesses are small, so they don't get a lot of opportunity to network and grow," said Patrick.

Having a location close to Tech, where the computer science department has grown exponentially over the past year, supports both students looking at going into the field of computer science and SAIC.

"We have interns and the ability to bring them on early leads to job integration and accelerated workforce development. We sponsor a lot of events for Tech like a summer camp, that allows us to be engaged with the students early. They learn about SAIC, which is good, because our business model is so unique. We're giving people the opportunity to grow and learn, its continuous education," Patrick said.

"We're also helping shape the curriculum at the school. In spring 2019, Tech put together a DevOps course. SAIC helped collaborate with the computer science department on the curriculum. This ensures that SAIC gets students trained in the latest methodologies and that the students are learning emerging technologies. We sponsored three capstone projects this year. We partner the capstone teams with someone at SAIC, then they do the entire lifecycle for software development. It's a really good partnership."

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