MINERBITS

Computer Science | Missouri S&T | Winter 2019

COMP SCI BUILDING TO EXPAND, BUT NEED REMAINS

page 4

DIVERSITY INITIATIVES

page 9

HELP US MODERNIZE THE COMPUTER SCIENCE BUILDING

The classroom is the place where students chart their futures. From the first day of class to the last, classrooms and laboratories are the start — and heart — of the learning journey.

S&T has announced plans to build a new Classroom Learning Center connected to the Computer Science Building. The 15,900-square-foot addition will include four 100-seat classrooms and a 300-seat lecture hall.

The buildings will meet in a lobby that we hope can become a commons area to give students and their professors a place to meet and interact in an informal setting.

We also hope to renovate a portion of our building to create a cybersecurity lab to further our research into the security and privacy of critical cyber-physical infrastructure systems.

Our department's annual phonathon is underway, and we hope you'll take time to talk with the student who calls. We also hope you'll help us raise the roof on expanding opportunities for our students by making a gift in support of our building renovations.

FOR INFORMATION ON NAMING OPPORTUNITIES PLEASE CONTACT:

Rebecca Johnson
johnsonnr@mst.edu
573-341-6161
give.mst.edu

DEAR ALUMNI, COLLEAGUES AND FRIENDS

Greetings from Rolla! I'm happy to return to the department after four years in the College of Engineering and Computing (CEC) dean's office and to be able to work more closely with our students, faculty and alumni in my new role as interim chair.

These are exciting times for computer science, perhaps the most exciting in my 30 years at Missouri S&T. We have built a strong research arm of the department; four of the top 30 researchers in the college of 220 are in CS. Our collective scholarship exceeds that of our aspirational institutions.

We have, perhaps, the largest student population ever showing intense interest in STEM education and interest in computer science and a corresponding demand for our graduates. Our thrusts in cybersecurity and data science are international leaders and the UM System looks to S&T as the cybersecurity lead.

Campus is investing in computer science. New projects to enhance the computer science building are in the planning stages. Remember standing in line to punch and submit your card deck? We want that space to become a student commons where students and faculty can mingle. The old keypunch room? Now it will be an advanced research lab. The college sees computer science as a future major pillar of the institution's research and education effort.

We continue to increase quality. Computer science has joined with the campus in a common first-year experience (programming for all!). Class sizes are growing due to economic issues, and we look toward technology to help both on-campus and distance/online learners participate in different ways in such settings. On the research front, one of the biggest challenges will be to double our research while maintaining academic quality.

Finally, I want to thank **George Markowsky** for leading the department over the last year, he has brought many fresh ideas to the department in terms of student engagement, and he has agreed to continue on the department's leadership team.

We'd like to hear from you. Feel free to visit, call, send an email, or follow the department and me on Facebook and Twitter.

Warm Regards,

Bruce McMillin
Interim Chair and Professor of Computer Science

IN THIS ISSUE

2 **Student profile: Kristi Arroyo**
This December 2018 computer science graduate took everything she learned at S&T — both in the classroom and everywhere else — to her new job at Accenture in Kansas City, Mo.

3 **There's a robot for that**
With funding from the NSF, Zhaozheng Yin is studying algorithms that could predict and control the way humans interact with robots in the workplace.

4 **Comp Sci Building to expand, but need remains**
S&T is constructing a new classroom facility that will connect to our building, giving us an opportunity to update our own facilities.

7 **McMillin, colleagues receive $962K NSF grant for cyber physical system security**
Critical national infrastructure systems, like water supplies, the electric grid, airline systems and medical devices, may one day be safe from cyberattack thanks to safeguards being developed at S&T.

STUDENT PROFILE:

KRISTI ARROYO

When **Kristi Arroyo**, CSci'18, first came to campus on a PRO Day (Preview, Registration, Orientation) before classes started, her first impression was that everything seemed shiny and new.

"I was just really overwhelmed, but in a good way," Arroyo says. "This was the place I was going to come. It was mind-blowing."

The Houston, Texas, native had heard of S&T long before she got here, and she knew this was the place for her.

"Missouri S&T has a prominent presence in Houston," she says. "I attended a seminar about the school that included two students who were in town on co-op. I really loved how Missouri S&T emphasized preparing students for the workforce."

Arroyo says she chose her major after attending a coding workshop the summer before her freshman year.

"I loved how much thought was involved in solving the problem at the workshop and how passionate everyone there was," Arroyo says. Soon after arriving at S&T, she went to her first Grace Hopper conference.

During her time at S&T, she has developed networking skills and learned more about her field at several national conferences. She has held internships at Berkeley National Laboratory, Sandia National Laboratory and two Intel locations, gaining not only experience in her field, but confidence in herself and her place in the world. And she conducted undergraduate research with **Donald Wunsch**, the Mary K. Finley Missouri Professor in Computer Engineering at S&T.

> "I fell further in love with the major and the opportunities I was given as part of the computer science department."

"I fell further in love with the major and the opportunities I was given as part of the computer science department," she says. "I have learned so much outside what the classrooms could teach me. Being at Missouri S&T helped shape who I am overall as a person today."

The person she is today is passionate about volunteering, working as an officer and volunteer for ACM-W to help inspire young women to be part of solving problems in STEM fields. She also taught a coding class at the local junior high school.

After graduation, Arroyo moved to Kansas City to start work in Accenture's Technology Development Program. She hopes to continue her education, eventually get a master's degree in computer science and then work in a national research laboratory solving problems that make a great impact on the world.

"I want to continue to be involved in the leading edge of technology to help have a better understanding of the world through data analytics."

THERE'S A ROBOT FOR THAT

In the spirit of the U.S. government's National Robotics Initiative, which aims to accelerate the development and use of robots that work beside and with people, **Zhaozheng Yin** is targeting the manufacturing industry for new human-robot partnerships.

With funding from the National Science Foundation, Yin, an associate professor of computer science and St. Clair Fellow, is researching an integrated set of algorithms and robotic test beds to sense, understand, predict and control the interaction of humans and robots in the workplace.

Working with Yin on this collaborative research project is **Ming Leu**, the Keith and Pat Bailey Missouri Distinguished Professor of mechanical and aerospace engineering at S&T. Together, they hope to significantly improve the safety and productivity of hybrid human-robot systems, which in-turn will promote additional hybrid work environments in future "smart factories."

The researchers will have to tackle the challenges of human-robot collaboration, such as the limitation of one-to-one sensing between humans and robots, the lack of adaptive modeling methods for reliable recognition and prediction of human actions and motions in different manufacturing scenarios, and multi-scale human-robot coordination. Yin hopes to face these issues through multi-disciplinary research involving machine learning, sensing and robot path planning.

Yin's overall goal is to develop new algorithms that can sense and recognize where objects like robots, humans, tools and parts are located and predict what the next human action will be in a workplace, and then plan and control individualized robot trajectories with a focus on safety and avoiding worker injury.

WELCOME OUR NEW FACULTY

Since our last newsletter, computer science has hired several new faculty members. Some may be familiar faces. Help give a warm welcome to:

Michael Gosnell, MS CSci'03, was named assistant teaching professor of computer science in 2018. For several years, Gosnell has mentored and instructed S&T students as a lecturer in our department. He co-founded Triplet Tech Corp., which offers new technology and software solutions to customers. He also worked for 21st Century Systems Inc. as a computer scientist assisting small businesses and government entities with technology projects. His teaching interests include software engineering, databases and parallel programming.

George Markowsky, professor of computer science, joined the department in 2017 and served as chair for a year. Markowsky has a background in entrepreneurship, international education and cybersecurity research. He earned a Ph.D. in mathematics from Harvard University. He came to Missouri S&T from the University of Maine, where he served as a professor of computer science

Sid Nadendla, assistant professor of computer science, came to S&T in 2018 from the University of Illinois at Urbana-Champaign, where his research focused on the design and analysis of human-system interaction, security and deception in cyber-physical-human systems, and learning choice preferences with the aid of private signals. He earned his Ph.D. in electrical and computer engineering from Syracuse University.

Patrick Taylor, assistant teaching professor of computer science. Taylor's research interests include learning algorithms, graph theory, neural networks, human-systems interaction and bio-inspired artificial intelligence. He earned a Ph.D. in neuroscience and behavior from the University of Massachusetts, where he held a post-doctoral position in the College of Information and Computer Sciences.

Peizhen Zhu, assistant teaching professor of computer science, joined us in 2017. Zhu's research background is in computational mathematics, and she previously served as an assistant teaching professor in mathematics and statistics at S&T. She holds a Ph.D. in applied mathematics from the University of Colorado Denver.

Comp Sci Building to expand, but need remains

The Computer Science Building will soon have a new look, significantly more space and improved infrastructure as part of a $7.65 million expansion.

The University of Missouri Board of Curators approved plans to build a new Student Classroom Learning Center in late September. The center will be a two-story, 15,900-square-foot addition to the Comp Sci Building and will include four 100-seat classrooms, one 300-seat lecture hall and a new entry lobby.

The lobby is envisioned as a "student commons" area where young learners and their faculty counterparts can interact more informally between classes or over coffee or lunch — more akin to the current set-up in nearby McNutt Hall. The department also hopes (with your help) to construct a cybersecurity lab in the original part of the building.

The project is expected to be completed by late 2019 for use during the spring 2020 semester, which will begin that January.

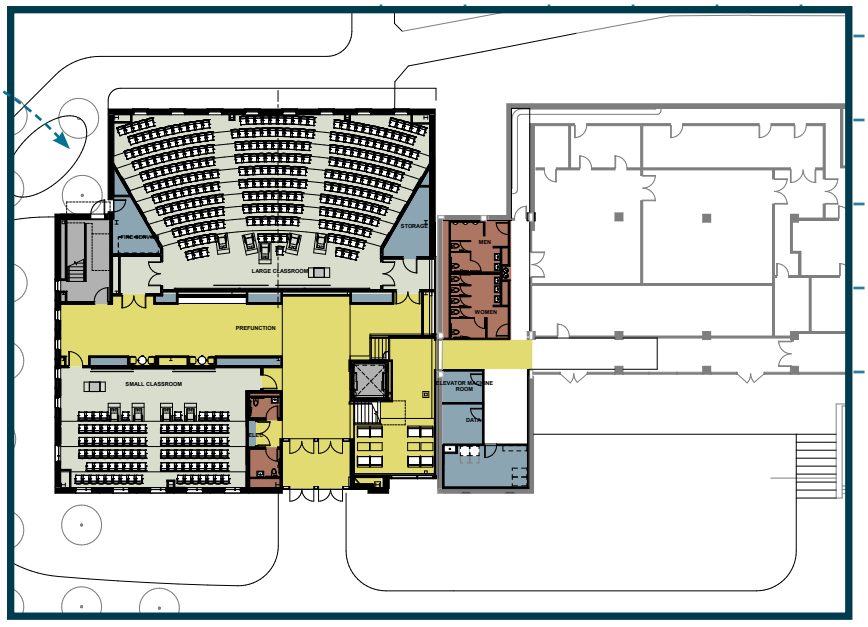
"Missouri S&T's enrollment growth over the past several years has strained our ability to provide adequate classroom space," says **Christopher G. Maples**, Missouri S&T interim chancellor. "This project will help alleviate that strain by providing much-needed classrooms for our students."

Enrollment at S&T has grown by 23 percent since 2010, and larger classrooms are needed to accommodate this increase, Maples says. Currently, S&T has only one classroom that can accommodate between 76 and 100 students and only two lecture halls with capacity for over 215 students. Construction of this addition is anticipated to generate as much as $1 million in savings annually once it is fully in use.

The Student Classroom Learning Center also will include accessibility and safety improvements to the adjoining Computer Science Building. These include a fire suppression system and security improvements to exterior doors.

"Like the campus at-large, computer science has experienced significant enrollment growth in recent years," says **Bruce McMillin**, interim chair and professor of computer science. "This new building will greatly benefit students and faculty in our department as well as on the broader campus."

The department enrolled more than 700 undergraduate and graduate students in fall 2018, making CS the second-most popular field of study on campus. A combination of charitable gifts, maintenance and repair funds, and campus reserves will fund the $7,657,675 project.



The first floor of the Student Classroom Learning Center, expected to be open for the spring 2020 semester, will feature a 300-seat lecture hall and a new entry lobby. The lobby is expected to become a student commons area.

FU RECEIVES NSF GRANT TO STUDY BIG CROWD-SOURCED GEO-TAGGED DATA

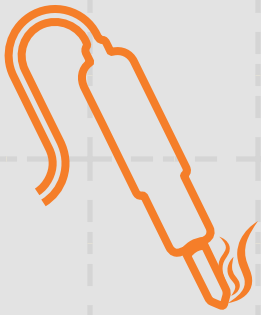
Checking in to a favorite theater on Facebook? Ordering dinner through an app? Using your car's built-in navigation system to meet a friend? For most of us, such real-time updates are as ephemeral as they come. Not for **Yanjie Fu**.

The assistant professor of computer science has received a $174,515 research grant from the National Science Foundation to study such geo-tagged data — specifically, how the voluminous Twitter posts, Facebook status updates and other location-based data that swirl around our daily lives can serve as an "invaluable source of intelligence for understanding urban vibrancy and enhancing smart growth."

"The algorithms and tools developed in this project will directly impact community planning, city governance and urban economics," Fu explains. His goal: "to develop new analytical techniques to discover, analyze and leverage the patterns within and the relationships among so-called big crowd-sourced geo-tagged data (BCGD) to understand and sustain urban vibrancy."

The two-year research project is titled "Understanding Urban Vibrancy: A Geographical Learning Approach Employing Big Crowd-Sourced Geo-Tagged Data."

YANJIE FU
Assistant professor of computer science



ACM, ACM-W UPDATE

Our main student organizations, the Association for Computing Machinery (ACM) and the Association for Computing Machinery's Council on Women in Computing (ACM-W), have been very active.

ACM now has six special interest groups or SIGS with active membership — SIG-Competition, SIG-Hack, SIG-Data, SIG-Game, SIG-Web, and the largest, SIG-Security. Read more about the groups at **acm.mst.edu/sigs**.

ACM-W is organizing a soldering workshop, a dinner with women technologists, and right before advising week, peer-advising. These events are a great way for students to build a social and technical sense of community outside of class.

The leaders of these organizations form a leadership council that joins industry, alumni, and advisory board and the academy as departmental stakeholders.

In the future, we're looking to revive our honor society, Upsilon Pi Epsilon (UPE).

FACULTY UPDATES

Awards

» **Sajal Das**, professor and Daniel St. Clair Endowed Chair of computer science, received the UM System President's Award for Sustained Career Excellence in April 2018. The award recognizes faculty who show a demonstrated and sustained record of distinguished scholarship, research or creative work for a period of 15 or more years.

» **Sanjay Madria**, was named a Curators' Distinguished Professor of computer science in May 2018. The honorary title bestowed by the University of Missouri Board of Curators recognizes Madria's work in cloud computing, wireless computing, security and mobile data management. He also received a 2017 Faculty Research Award.

» **Jennifer Leopold**, associate professor of computer science, **Daniel Tauritz**, associate chair for undergraduate studies and outreach activities and associate professor of computer science, and **Ricardo Morales**, assistant teaching professor of computer science, received the S&T Outstanding Teaching Award for both 2017–18 and 2016–17. The distinction recognizes faculty members who have demonstrated excellence in teaching-related activities. Leopold also received the 2017 Faculty Teaching Award.

Promotions

» **Zhaozheng Yin** was promoted to associate professor of computer science with tenure in September 2017. He was also named an inaugural Dean's Scholar in spring 2017 by the College of Engineering and Computing. The CEC award recognizes prodigious research, teaching excellence and campus service among junior faculty. In addition, Yin received a campuswide Faculty Research Award in 2017 and again in 2018.

Presentations

» Five computer science faculty were among the nearly two dozen researchers representing each of the four University of Missouri System campuses to present at the S&T-hosted inaugural UM Cyber Summit in April 2018. **Sajal Das**, **Sanjay Madria** and **Bruce McMillin** shared their work with a group that included UM System President **Mun Choi**, with an eye toward building cross-campus collaborations designed to compete for major new funding opportunities.

ENTREPRENEURSHIP: 101

George Markowsky, professor of computer science, is bringing his entrepreneurial expertise to the CS entrepreneurship courses started by **John Lovitt**, MS CSci'70, and **Sajal Das**, professor and Daniel St. Clair Endowed Chair in Computer Science.

The new course will have significant computer science content by pairing with teams from senior design and will mimic the National Science Foundation iCorps program structure.

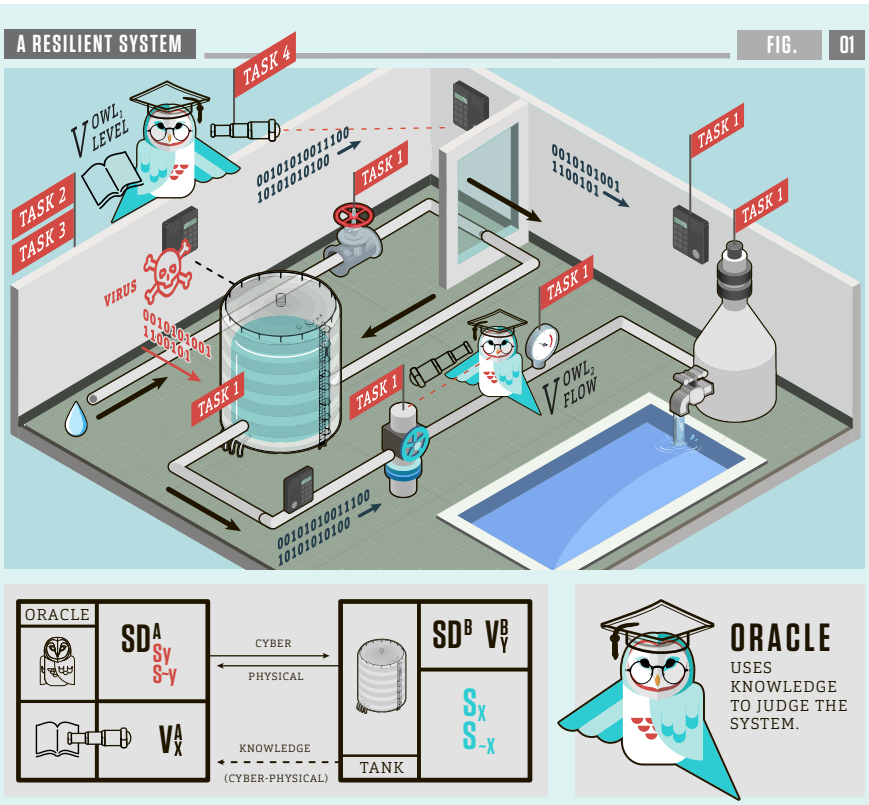
McMillin, colleagues receive $962K NSF grant for cyber-physical system security

A team of S&T researchers led by computer science professor and interim chair **Bruce McMillin** has received a nearly $1 million National Science Foundation grant to develop stronger safeguards for cyber-physical system security.

"The nation's critical infrastructures are increasingly dependent on systems that use computers to control vital physical components, including water supplies, the electric grid, airline systems and medical devices," the NSF award summary reads. "These are all examples of cyber-physical systems (CPS) that are vulnerable to attack through their computer systems, through their physical properties such as power flow, water flow, chemistry, etc., or through both."

> "The research aims to ensure that such systems 'do what they're supposed to do' despite an attack..."

"The research aims to ensure that such systems 'do what they're supposed to do' despite an attack by building in defenses that make sure each component behaves and works well with others," McMillin explains. The objective: produce from untrusted components a trusted CPS that is resilient to security attacks and failures.



A sample cyber-physical system is a water treatment system in which each component is in its own security domain. Each portion of the process is monitored (each with a wise owl who is an oracle of knowledge) through a valuation V (its spyglass) from that domain to other domains that contain information from the physical owls, cyber owls and knowledge in the form of invariants (the books) to ensure system operation. *Figure by Sarah Martin*

Jonathan Kimball, S&T professor of electrical and computer engineering, **Rui Bo**, assistant professor of electrical and computer engineering, and **Jennifer Leopold**, associate professor of computer science, are co-principal investigators.

The project will test the more robust CPS systems on a high-fidelity water treatment system as well as an electrical power test bed, aligning "concepts from distributed computing, control theory, machine learning and estimation theory to synthesize a complete mitigation of the security and operational threats to a CPS," McMillin adds.

"The key difference from current methods is that security holes will be identified and plugged automatically at system design times, then enforced during run time without relying solely on secure boundaries or firewalls."

ALUMNI NOTES

- **Diane Butrus**, CSci'85, received the Alumni Merit Award during Homecoming festivities in October. Butrus, chief operating officer of Diba Imports LP, is also a member of the College of Arts, Sciences, and Business Dean's Leadership Council. **John Lovitt**, MS CSci'70, received the same award in 2016. Lovitt is the retired CEO of Pattern Insight.

- **John M. Brown**, CSci'85, a contract program and project manager in the engineering department at Nestle Purina, was inducted into the Academy of Computer Science in October. Brown, who has been with Nestle Purina since 2002, oversees numerous projects that focus on enhancement and improvement in manufacturing.

- In April 2018, **Meg Brady**, CSci'83, MS CSci'89, was named the second recipient of the Dr. Elizabeth Cummins Women's Advocate Award. The award is given to any Missouri S&T employee, regardless of gender or job designation, that demonstrates commitment to the women on campus through mentorship and advocacy and by setting an example through professional achievement. As part of the award, Brady received a $1,000 stipend funded by **Cynthia Tang**, Econ'85, founder and former chair of Insight Industries Inc. and a member of the Academy of Computer Science and the Academy of Electrical and Computer Engineering.

STUDENT COMPETITIONS

It's a big year for students with several competitions to test their knowledge and skill:

PICKHACKS/SHAMHACKS

PickHacks is coming to S&T in March. PickHacks brings together 300 of the brightest minds around the nation for 36 hours of building, collaboration and fun. Our mission is to empower students to explore, learn and create by providing a supportive and welcoming environment. This year's theme is athletics — health technology to sports analytics — and students will pick problems to solve. Read more about the competition at **pickhacks.io**. The organizers, led by computer science junior **Christopher Gu**, have already raised over $30,000 on their own to support the project. This follows from Shamhacks, held earlier this year, which brought 100 local teams. Watch a video from the competition at **rol.la/Shamhacks**.

COLLEGIATE PENETRATION TESTING COMPETITION

In the fall, S&T, led by **George Markowsky**, hosted a regional Collegiate Penetration Testing Competition (CPTC), which provides a vehicle for up-and-coming cybersecurity student teams to build and hone the skills required to effectively discover, triage and mitigate critical security vulnerabilities. "This competition is unique in offering a simulated environment that mimics real-world networks," says **Bruce McMillin**, interim CS chair. "The competition focuses on improving the security posture of a fictitious organization and reporting on risks in a manner that is similar to a real professional environment." S&T hosted seven teams on campus.

CYBERSPARK

CyberSpark, which was last hosted in August 2018, is a beginner-friendly cyber security wargame run by the U.S. Department of Energy and Los Alamos National Laboratory. The series of small challenges was done in teams of four. **Chris Rawlings**, CSci'15, CpEng'15, a scientist at Los Alamos, led this capture-the-flag event for 48 future cybersecurity experts.

TRACERFIRE

TracerFIRE, a cybersecurity competition that includes incident response, forensic investigation and analysis, file systems, memory layout, and malware analysis run by Sandia National Labs was last held in August 2017experts.

CCDC (COLLEGIATE CYBER DEFENSE COMPETITION)

Student teams assume administrative and protective duties for an existing commercial network, typically a small company with 50-plus users, seven to 10 servers and common Internet services such as a web server, mail server and e-commerce site.

DATAFEST

DataFest, held at Mizzou, was a celebration of data in which teams of undergraduates work around the clock to discover and share meaning in a large, rich and complex data set. This is part of our new Data Science ACM SIG. ACM sponsors the ever-popular Cantenna build and war-driving competition. Students build a directional external antenna for their computers out of a tin can. Participants bring it to the Wireless Security Audit on April 4 and drive around Rolla searching for wireless networks in a war-driving competition.

DIVERSITY INITIATIVES

With support of the BRAID (Building, Recruiting and Inclusion for Diversity) Foundation, Missouri S&T once again sent 20 students from under-represented groups to the annual Grace Hopper conference in Houston. The department chair attended as well to check out the scene.

There was a palpable excitement in the air among our students as they had the big companies fighting over them. "I didn't know they were so interested in us," one student commented. "Wow."

Back on campus, associate professor **Jennifer Leopold** is heading up a diversity task force to take proactive steps to improve diversity through recruitment and retention at both the graduate and undergraduate levels.

Perhaps, one day, computer science will have parity with the actual population.

Top: Missouri S&T sent 20 students to the Grace Hopper Conference in Houston. The annual conference, a combination of technical and career sessions is billed as the world's largest gathering of women technologists.

Bottom: Interim department chair Bruce McMillin, pictured here with Henry Wong, also attended this year' s conference.

LIKE FATHER, LIKE SON

Gary and Dylan Warren learn computer science side-by-side

A career in commercial refrigeration repair and distribution paved the way for recent CS graduate **Gary Warren**, CSci'18, to enroll at S&T at a stage in life when many count the days until retirement. His midlife example has led Gary's son, **Dylan**, to our department as well, making for a father-son fixture around the Computer Science Building.

For Gary Warren, 52, enrolling at S&T in the summer of 2014 was the culmination of a lifelong desire that got sidetracked by his work and familial responsibilities. After earning his bachelor of computer science degree in May, Warren is now enrolled in S&T's graduate program in engineering management.

"Through the years, I always wished I had that opportunity, but growing and building my business, I never did," says the owner of Gary Warren Service Industries, a business in nearby Lebanon, Mo., that he still operates while in school. "I was able to fill that bucket list deal and at the same time be an inspiration for Dylan."

Dylan Warren, now in his fourth year at S&T, came to the department in hopes of an eventual career as a video game designer. His focus has since shifted to AI and cybersecurity. He works as an assistant to assistant teaching professor **Clayton Price**, and leveraged his S&T experience into a 2017 summer internship with IntelliFarms, a company south of Kansas City that helps farmers incorporate big data into their operations.

MISSOURI S&T
Computer Science
325 Computer Science Building
500 W. 15th St.
Rolla, MO 65409

GRADUATION DOESN'T MEAN GOODBYE

It's easy to stay in touch with your department. We'd love to hear about new appointments, degrees earned, job promotions and other family or professional news.

Get in touch with your department by emailing **csdept@mst.edu**. Tell us what you're doing with your degree in computer science so we can feature your accomplishments among our alumni achievement stories.

Ryan Stoughton, CSci'18
Programmer analyst at Boeing