The culture of Michigan Technological University’s Department of Computer Science is changing. The department strives to build strong research and teaching environments, preparing students to learn, discover, innovate, and apply new knowledge in computer science. We accomplish this through balanced research programs, undergraduate and graduate teaching, outreach, and service.

Computing is a discipline without boundary. Our faculty seek opportunities to collaborate with colleagues in engineering, sciences, and business to conduct interdisciplinary research. The department currently has 20 faculty members, including 16 tenured and tenure-track professors and three lecturers.

I’m thrilled to say 15 Computer Science professors received external funding as Principal Investigators or Co-Principal Investigators in 25 research grants totaling more than $5 million in fiscal year 2016. Our department received $3.1 million of that total—this means our new research funding has an annual increase of 235 percent! On the teaching side, one professor received the University’s Distinguished Teaching Award and became a member of the Michigan Tech Academy of Teaching Excellence. Five professors were recognized by the University as faculty in the top 10 percent of student evaluations.

This great success is attributed to our devotion to computer science research and education, and a healthy working environment of involvement, collegiality, empowerment, and respect. I am proud to say our faculty are engaged with alumni, industry, local communities, and professional societies in conducting cutting-edge research and impactful educational activities. All things working together, computer science faculty published 68 conference papers, 20 journal articles, nine book chapters, and one book in the past academic year.

The computer science department is also proud to lead computing-related research and educational programs at Michigan Tech. In particular, the department plays an important role in Michigan Tech’s Institute of Computing and Cybersystems (ICC). ICC was established in June 2015 to promote research and scholarship in the field of computing and computing-related areas. Currently, ICC has 44 members from 12 departments and schools—including 16 computer science faculty members. As ICC’s founding director, I encourage you to visit icc.mtu.edu for details about our achievements.

On the education side, the computer science department initiated and is now administering the MS in Cybersecurity degree program. This graduate degree is unique because of the combinations of learning environments, including departments and schools in science, engineering, technology, and business.

Toward the end of this report, you will find alumni and friends who support the department. I thank every one of them for their generosity. I especially want to thank Dave House who gave $1 million to support an endowed professorship. “These gifts are not only a testament to the importance Michigan Tech continues to have with our alumni, but they demonstrate the increased priority on computing and cybersystems as the world enters 2016,” Michigan Tech President Glenn Mroz said. “Dave House’s generosity will help ensure we have sustainable faculty positions to educate our students who go on to leadership positions in these fields.”

Enrollment continues to increase with 450 undergraduates and 49 graduate students. To increase diversity in the student body, the department initiated special efforts to attract more female students. As a result, first-year women made up 17 percent of our student body last year—a record high. Please visit mtu.edu/cs for more details about our degree programs.

It is my pleasure to present this research report to you. You will find our faculty have diverse research interests in architecture, artificial intelligence, cloud computing, cybersecurity, data science, distributed systems, embedded and multimedia systems, graphics and visualization, human-computer interaction, machine learning, mobile computing, software engineering, virtual environments, and wireless networks. In addition, we highlight research projects, achievements, and facilities available within research centers and laboratories.

The department has had great success in research, while maintaining excellence in teaching and service. I hope you find this report informative, exciting, and useful. Thank you for reading.

Best regards,

Min Song
David House Professor and Department Chair
# Mission Statement

We prepare students to learn, discover, innovate, and apply new knowledge in computer science through a balanced program of cutting-edge research, effective teaching, and outreach and service.
Our degrees are code for success

The Department of Computer Science at Michigan Technological University continues to expand undergraduate, master’s, and PhD programs. Our degrees meet student needs and the demands of industry and academia.

Our core strengths are in computing systems, systems software, and parallel computing.

Our faculty’s expertise includes software engineering, human-computer interaction, virtual environments, data analytics, and visualization.

Research areas include:
- Software and hardware foundations
- Large-scale computing
- Human-centered computing
- Mobile computing
- Cybersecurity

Undergraduate Degree Programs

BS in Computer Science
From modeling and analysis to design and reliability, a bachelor’s in computer science from Michigan Tech prepares students to design everything from business applications and operating systems to network control systems and computer games. Theory, experimentation, and engineering design are emphasized.

Students specialize in one of five concentrations:
- Computer science
- Computer systems
- Applications
- Education
- Game development

BS in Software Engineering
Software engineers design and develop software applications and systems. Michigan Tech’s curriculum is team-based, modeled after real working environments. Students hone team and software skills through Senior Design and Enterprise.

Minor in Computer Science
A minor in Computer Science can be combined with any of Tech’s other degrees.

Graduate Degree Programs

MS or PhD in Computer Science
Students can pursue a graduate degree in computer science tailored to their specific interests.

MS in Cybersecurity
One of our newest degrees, the MS in Cybersecurity provides students opportunities to pursue cross-disciplinary graduate study of theories with the knowledge of science, engineering, and technology, preparing them for a career in information security. Students select one of three concentrations:
- Trusted Software Engineering
- Critical Infrastructure Protection
- Network Security Management

Accelerated Master’s in Computer Science
The Accelerated Master’s in Computer Science is designed for students who want to fast track their education to pursue doctoral studies in computer science or gain a competitive edge for a career in industry. Our program allows students to count up to 6 approved credits toward both an MS in Computer Science and a BS in Computer Science, or Software Engineering. Students choose from a thesis option, a report option, or a coursework option.
Technology and Facilities
To support their research and studies, students work with the latest industry technology, including:
- IBM Systems p5 dual 4-core systems
- Multiple clusters with various types of interconnection networks
- Apple- and PC-based graphics systems
- Visor-based augmented reality system
- Pioneer 3 AT vision-equipped mobile robot
- Mobile usability testing lab
- 32-processor HP SC-40
- 40-processor Cray T3E
- 12-processor Sun Enterprise 4500

Students have access to five labs, including:
- Artificial intelligence/robotics lab
- Cluster computing lab
- Compiler/architecture lab
- Graphics and visualization lab
- Human-computer interaction lab

For more information about our degrees, technology, and facilities, visit mtu.edu/cs.
Tim Havens

ASSOCIATE PROFESSOR, COMPUTER SCIENCE
ASSOCIATE PROFESSOR, ELECTRICAL AND COMPUTER ENGINEERING
WILLIAM AND GLORIA JACKSON ASSOCIATE PROFESSOR
ASSOCIATE DIRECTOR, INSTITUTE OF COMPUTING AND CYBERSYSTEMS

EXPERTISE
- Sensor fusion
- Autonomous mobile robotics
- Big Data
- Explosive hazard detection
- Wireless sensor networks

Tim Havens ’99 ’00 earned his PhD in Electrical and Computer Engineering from the University of Missouri. There, his research focused on multi-modal data fusion, detection algorithms, and fuzzy clustering. As a National Science Foundation/Computing Research Association Computing Innovation Fellow at Michigan State University, Havens developed machine-learning methods for clustering in large heterogeneous data sets. He also served as technical staff at Massachusetts Institute of Technology’s Lincoln Laboratory where, with support from the United States Air Force, he analyzed airborne-directed energy systems, laser-illuminated target-ID systems, and GPS signals.

Havens coauthored more than 80 technical publications and serves as associate editor of IEEE Transactions on Fuzzy Systems. The Michigan Department of Transportation, the United States Department of Transportation, the United States Army, the RAND/John A. Hartford Foundation, and the Leonard Wood Institute have all funded Havens’ work.
To detect buried explosive hazards in places like Afghanistan, and to save the lives of civilians and US soldiers, Michigan Tech researcher Tim Havens realizes it requires a team—a team of sensors.

A new $983,000 research project, “Heterogeneous Multisensor Buried Target Detection Using Spatiotemporal Feature Learning,” will look at how forward-looking ground-penetrating radar, LiDAR, and video sensors can be combined synergistically to see into the ground, capture high-quality images, and then automatically notify the operator of threats. With funding from the US Army Research Office, Havens and Tim Schulz, professor of electrical and computer engineering at Michigan Tech, will work with three PhD students to create a high probability-of-detection/low false-alarm rate solution.

“It’s a very difficult problem to solve because most of the radar energy bounces right off the surface of the earth,” says Havens, the William and Gloria Jackson Assistant Professor of Computer Systems at Michigan Tech. “This technology has the potential to not only save lives, but also to advance the basic science of how to combine sensors and information together to get a whole better than the sum of its parts.”

This new project will advance additional sensor-related work Havens and collaborators completed between 2013–2015. The US Army-funded project studied signal processing and computer-aided detection and classification using forward-looking, ground-penetrating, vehicle-mounted radar.

The Army currently fields ground-penetrating radars in its fleet. The problem is they cannot detect hazards until they’re right above them, putting a multi-million dollar radar—and soldiers—directly in the path of danger.

“The big ideas here were to process data to obtain better images, see into the ground in a high-fidelity manner, and develop algorithms to automatically find buried threats—notifying operators of what the possible threats actually are,” Havens adds.

Havens has partnered with the Army since 2008 when he was a PhD student.
TRANSFER LEARNING IN DATA CENTERS


Big companies like Amazon and Google have even bigger data centers. Think 30 data centers each with 50,000 to 80,000 servers. And the underlying computer processors are not all identical; each year new improvements are integrated and added. Brown, Wang, and computer science colleagues from Western Michigan University are digging deep into the management of memory resources in these larger-than-life data centers.

The researchers use machine-learning techniques to create models that predict the cache and memory requirements of an application.

The challenge is how to make accurate predictions with such a massive variety of applications using the data center, and the different computers the application runs on. Applications might include Netflix streaming a movie, Airbnb running database queries, or NASA processing satellite images. Each app is not run in isolation with a dedicated machine. To maximize resources, data centers may have two or more applications all running on a single machine.

“If we learn the memory requirements of application A on computer X, what if the same app runs on machine Y or machine Z? Or, what memory resources will be available if A, B, and C all run together?” Brown asks.
Laura Brown

ASSOCIATE PROFESSOR, COMPUTER SCIENCE

EXPERTISE

- Artificial intelligence
- Machine learning
- Data mining

Laura Brown holds two master’s degrees—one in Computer Science from the University of Michigan—and a master’s and PhD in Biomedical Informatics from Vanderbilt University. Her research interests include creation of methods in artificial intelligence and machine learning and their application in areas of clinical medicine, biology, electrical power systems, microgrids, and computer systems.

Brown is a member of the Michigan Tech Institute of Computing and Cybersystems and the Center for Agile Interconnected Microgrids. She is credited with helping start an interdisciplinary graduate program in Data Science at Michigan Tech, as well as co-advising the Women in Computing Sciences student organization. Since 2012, she has been involved in artificial intelligence education efforts, including serving as co-chair of the Symposium for Educational Advances in Artificial Intelligence.

Her work has been featured in Machine Learning and Engineering Applications of Artificial Intelligence and conferences on artificial intelligence, engineering, and computer science education.
TINY MICROGRIDS, FIERCELY IMPORTANT

A microgrid is a stand-alone power grid requiring generation capabilities (often generators, batteries, or renewable resources) plus control methods to maintain power flow. Electronics, appliances, and heating or cooling are all responsible for consuming that power. In this project, Brown and other Michigan Tech researchers are investigating a control system for such microgrids that are autonomous—aable to work in isolation—and agile, flexible to rapid changes in the configuration of the electric grid to incoming sources and consumers of power.

The world of microgrids is layered, each layer with a different purpose and speed. For stable power, the controls for the microgrid are considered hierarchically: low-level control responds to fastest events, and maintains regulation of stable voltages and currents in the system; the upper layer of control is responsible for power distribution, optimization, and long-term planning and prediction of resource availability and use. Brown’s work focuses on this high-level analysis in resource prediction at several timescales—in the next few minutes, next hours, next days. What if a generator is out of service for maintenance—what can be done? Brown uses artificial intelligence, machine learning, and experts in other domains to turn off non-critical resources or add new power sources.

The United States Department of Defense and the Army Research Lab seek the expertise of interdisciplinary Michigan Tech researchers to solve, prevent, and adapt to these potential real-world scenarios.

“Say fuel delivery will be delayed. What can be done?”
POWER GRIDS AND PEOPLE

Today’s infrastructure is connected in ways not always known until problems like extreme weather, diseases, major accidents, terror, or cyber threats arise.

Sixteen critical infrastructure sectors—including water, gas, energy, communications, and transportation—are linked and interdependent. The National Science Foundation is supporting new fundamental research to transform infrastructure from physical structures to responsive systems. The Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) program supports a collaborative project for Brown, along with Wayne Weaver, and Chee-Wooi Ten, associate professors of electrical and computer engineering at Michigan Tech, and colleagues from the University of New Mexico, Texas Tech University, University of Tennessee–Knoxville, and Fraunhofer USA Center for Sustainable Energy Systems.

Motivated by distributed renewable resources like solar panels and wind turbines, Brown and her research partners seek to ensure the resiliency of three interdependent networks: the electrical grid, telecommunications, and related socio-economic behavior. The team will look at how people react to power management in extreme conditions. Understanding and modeling human responses is necessary in the design of intelligent systems and programs embedded in devices that control and consume power.
Scott Kuhl

ASSOCIATE PROFESSOR, COMPUTER SCIENCE
AFFILIATED ASSOCIATE PROFESSOR, APPLIED COGNITIVE SCIENCE AND HUMAN FACTORS
FACULTY ADVISOR, HUSKY GAME DEVELOPMENT

EXPERTISE

- Immersive virtual environments
- Human-computer interaction
- Computer graphics
- Visual perception

After earning a BS in Computer Science and a BA in Mathematics from Augsburg College, Scott Kuhl graduated with a PhD in computer science from the University of Utah in 2009. He leads a virtual environment lab on campus and works with a team of Michigan Tech researchers to run the Immersive Visualization Studio. Kuhl also serves as faculty advisor of Husky Game Development, an Enterprise of more than 60 students who develop computer, console, and smartphone games for business, education, and fun.

Kuhl collaborates with Tech’s School of Technology, and Escanaba, Michigan-based, Bay College to write industrial robotic education software. The NSF-funded open-source software provides introductory-level course offerings to high school teachers and community colleges. With funding from the Department of Labor, Kuhl is also building interactive web tutorials on programmable logic controllers. PLCs, found in factories and industrial facilities around the world, are essential for everything from water treatment facilities to stoplights. Kuhl’s modules will help displaced workers, and high school and community college students to master PLCs effectively and efficiently.

Kuhl’s work has been regularly featured at the Association for Computing Machinery Symposium on Applied Perception. He is also active in the Michigan Tech Institute of Computing and Cybersystems.
The Wild World of Virtual Reality

As consumer costs for virtual-based products slide, Scott Kuhl’s interest in VR ramps up. “The technology used to be so expensive, only large companies could afford to use it. Now it’s on the brink of becoming more affordable and accessible, and we’re looking at how to make the systems useful for more and more users,” Kuhl explains.

If you think virtual reality can’t impact your everyday life, Kuhl says: think again. “Let’s say you’re in the market for a new home. You’re in Manhattan, but your home prospect is in Brazil. Virtual reality can be used to tour houses from anywhere in the world.”

Of course you’ll need to be able to judge size correctly. A typical problem with VR—much like with car mirrors—is that objects appear closer than they actually are. Kuhl, who’s worked in virtual-reality spheres since his PhD, goes on to explain how his research team intentionally distorts graphics to counter the issue. Newer, cheaper displays—like the Oculus Rift—appear to have reduced or eliminated the nagging distortion problem altogether. Are the newer head-mounted displays (HMD) better? Kuhl and his team will take a closer look.

Today’s gamers aren’t content sitting with a handheld control. They want to slap on an HMD and explore worlds under sea and in outer space. Until they crash. Into their living room wall. Solving this challenge not only has gaming implications, but safety, too. Together with PhD student Ruimin Zhang, Kuhl is studying how to walk freely around a big, virtual space in a tiny, confined room—like a dorm room. “It’s a given you’ll run into walls. We’re looking at tricks we can integrate without disrupting the user experience. For example, perhaps one real step equals two virtual steps . . . we can amplify user movement.”

After the gamer graduates, they may want to wear their HMD into the workplace. Kuhl says it can happen. The advantage of wearing one at work? Virtual screens and lots of them. “Just as iPads haven’t replaced desktops, I don’t think everyone will jump on board wearing a head-mounted display. But when they do, they’ll need to type, read, and talk.” Kuhl’s collaborating with colleague and text-entry expert Keith Vertanen and PhD student James Walker to address future VR needs.

“It’s on the brink of becoming more affordable and accessible, and we’re looking at how to make the systems useful for more and more users.”
ENDING OF MOORE’S LAW IS THE BEGINNING

Every field of science and commerce now relies on computers and their capability to process data and information—fast.

The ever-growing performance of computers is due to two main factors: our ability to shrink electronic circuits to smaller and smaller dimensions, and architectural innovation that improves how circuit elements interact with each other to perform computations. The former is commonly known as Moore’s law. Moore’s law enabled doubling the number of transistors that can be put on a chip every 18 months. This success continued for several decades.

When it became clear this path can’t be sustained, processor manufacturers shifted their focus to putting more processors on a single chip. Unfortunately, these processors cannot be programmed using the traditional software technique of writing sequential programs. Instead, programmers have to develop parallel programs. Parallel programs are difficult to write, debug, and maintain.

Since his CAREER award in 2003, Soner Onder has worked on alternative methods of building and programming processors. Contrary to existing execution paradigms, called Von Neumann architectures, Onder developed an alternative execution paradigm called Demand-Driven Execution. In this form of processor architecture and programming model, the execution of programs proceeds from the outputs of a program toward its inputs, and in the process, the machine automatically extracts all the available parallelism in the program and maps the extracted parallel operations to multiple processing elements. Unlike so-called multi-core computers, his approach does not require parallel programming. Instead, the execution paradigm itself automatically executes a given sequential program in parallel.

Onder’s most recent NSF grant is through the Exploiting Parallelism and Scalability program, which, according to NSF, “supports groundbreaking research leading to a new era of parallel computing.”

Michigan Tech is the lead institution in this four-year project totaling $875,000. The project will study demand-driven computing to meet existing and emerging workload demands. Onder is working with four PhD students and colleagues from Florida State University to establish demand-driven computing as a viable approach to build faster and more power efficient computers.

“Moore’s law enabled doubling the number of transistors that can be put on a chip every 18 months.”
Soner Onder

PROFESSOR, COMPUTER SCIENCE
DIRECTOR, COMPUTER ARCHITECTURE LABORATORY
AFFILIATED PROFESSOR, ELECTRICAL AND COMPUTER ENGINEERING

EXPERTISE
- Architecture
- Simulation
- Programming languages

Soner Onder holds an MS in Computer Engineering from Middle East Technical University and a PhD from the University of Pittsburgh. Onder leads the Computer Architecture Research Lab and is a member of the Institute of Computing and Cybersystems and the Center for Scalable Architectures and Systems. His 13-year partnership with the National Science Foundation began with his Information Technology Research award in 2003 and CAREER Award in 2004, and continues through 2016.

Onder served as an NSF panelist and on the program committees of top conferences, including the International Symposium on Computer Architecture, MICRO, and the Symposium on High Performance Computer Architecture. He also served as a referee for the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers journals and conferences, and gave invited talks to École Polytechnique Fédérale de Lausanne in Switzerland and Chalmers Institute in Sweden.

Onder is the designer and implementer of one of the earliest architecture description languages, ADL.
BREAKING DIGITAL BARRIERS

Associate Professor of Computer Science Charles Wallace is rethinking cyberlearning top to bottom. He’s working with K–12 and undergraduate students, software development professionals, and senior citizens to improve how humans communicate and learn in computer-intensive environments.

There is a revolution sweeping the nation, but millions of senior citizens are left out. Wallace believes digital literacy is a basic human need in today’s world. In 2011, together with Michigan Tech faculty and students, he began BASIC (Building Adult Skills in Computing), a grassroots effort to educate older Americans. Every Saturday morning at Portage Lake District Library in Houghton, Michigan Tech students help local seniors citizens with their computers, tablets, or
smartphones, answering open-ended digital questions like, “how do I find an old friend on Facebook?” Or, “how do I stay safe online?” There’s much more going on during these tutoring sessions than meets the eye. “The visual, motor, and cognitive challenges of standard digital interfaces are daunting for older users with limited digital experience,” explains Wallace. But there are deeper challenges as well: “digital literacy is not simply about doing a task better; it’s about building a cognitive toolset that allows flexibility and adaptability.” The Michigan Tech students who work as tutors also learn in the process. “Students are forced to reflect on the many things they take for granted—they are learning by teaching.”

A key factor behind the success of BASIC, according to Wallace, is its highly social nature. Seniors work side by side with each other and with Michigan Tech students. Being around others with the same challenges reduces anxiety. “Many seniors have a fear of exploring for fear of breaking an expensive investment. Because we work in a group, they can share ideas and choices they made, so they have more confidence.”

Now in its fifth year, the outreach program has spawned research projects. In conjunction with interdisciplinary colleagues in Cognitive and Learning Sciences, Wallace uses data from tutor experiences to create a digital learning curriculum sensitive to the needs of older students. He is also reaching out to other communities to replicate the successful Houghton-based program.

In addition to the curriculum, Wallace is overseeing the creation of a computer software tool that allows users to remember online choices they made and recall web browser behavior. As the user develops competence, the tool fades into the background. This tool can transfer to other populations—not just elderly—who face similar digital obstacles.

The initiative is supported through Michigan Tech’s crowdfunding site Superior Ideas: superiorideas.org/projects/senior-tech. Learn more about Breaking Digital Barriers by visiting mtu.edu/bdb.

“Digital literacy is a basic human need.”
Charles Wallace
ASSOCIATE PROFESSOR, COMPUTER SCIENCE
DIRECTOR, UNDERGRADUATE COMPUTER SCIENCE PROGRAMS

EXPERTISE
- Cyberlearning
- Communication in software development
- Agile development methods
- Computer science and software engineering education
- Lightweight formal methods

Wallace studied linguistics at the University of Pennsylvania and the University of California before earning his PhD in Computer Science at the University of Michigan. His experiences as a computer scientist, linguist, and software developer drive his research exploring how humans can better understand, build, and use software. His work has been funded by the National Science Foundation, Google, Microsoft Research, and the US Department of Defense, and published by the International Conference on Software Engineering and the ACM Technical Symposium on Computer Science Education. In 2010, he was awarded a Fulbright Scholarship to visit the Pontifical Catholic University of Chile. Wallace currently serves as one of 20 Fulbright Alumni Ambassadors nationwide.

Wallace is the director of undergraduate programs for the Department of Computer Science and has been intimately involved with undergraduate curriculum development since his arrival in 2000. He cofounded the software engineering degree program in 2003 and in conjunction with his research projects, he founded local outreach efforts in computer education for middle and high school students and digital literacy for senior citizens. Wallace was presented with the University Distinguished Service Award in 2014 and in 2015 was invited to the White House and Congress to speak about his work.

Together with colleague Leo Ureel, Wallace launched the K-12 education outreach program Copper Country Coders, which introduces middle and high school students to the world of computer science and programming through weekly exploration sessions. The Google-sponsored project is free for students.

► LEARN MORE AT MTU.EDU/CODERS
Communication and teamwork are essential skills for computer science and software engineering graduates—but the traditional approach to introductory undergraduate computer science courses, focusing on individual programming assignments and discouraging collaboration, doesn’t prepare students for reality. Wallace breaks the mold and promotes interaction as a primary activity in software development. Inspired by real software teams using so-called agile methods, he and his team are building an introductory curriculum that gives students exposure to interpersonal activities like inquiry, critique, and reflection.

**Better Computer Science Education through Chemistry**

One tool in this effort—POGIL (Process-Oriented Guided Inquiry Learning)—is borrowed from undergraduate chemistry education, where it has been used successfully for 20 years. At the heart of POGIL is a guided inquiry learning cycle of exploration, concept invention, and application. Students work in small groups with well-defined roles—similarly to teams in agile software development—to encourage accountability and engagement. In essence, it is an application of the scientific method in a carefully crafted classroom setting. In addition to learning core concepts at the heart of the assignment, students get practice in team problem solving and communication.

WebTA is a software tool being developed by Wallace and his colleagues to provide automated critique of student programs. The tool is integrated with the Canvas Learning Management System to provide immediate feedback to students as they write code. Students using this tool are engaged in communication-by-proxy with the instructor. This communication is not meant to replace instructor feedback, but to codify common feedback scenarios to assist the instructor in reaching students in tight feedback loops just when the student is engaged in problem solving and learning (for instance, at 3 a.m. when the instructor is fast asleep). The instructor configures WebTA with interactive critiques triggered by errors, warnings, or textual analysis of the student’s code.

A third tool draws from research Wallace and a group of interdisciplinary colleagues conducted on team communication in software settings. Drawing from real-world examples including student projects and industrial case studies, students reflect on the characteristics and effectiveness of the written and oral communication they observe. The goal is to create a mindset that good communication requires design—choosing the right characteristics for the given setting. Later, when they are working with their own projects, students reflect on their own communication practices and those of other teams.

**Learning from Professionals**

Trends come and go in the field of software development, but communication between humans remains at its heart. Wallace is interested in deriving principles of effective software communication by turning to industry experts. Software developers communicate with clients, end users, and team members with very different perspectives and goals. Communication can cause problems because of the complexity (and invisibility) of software, competing goals of different stakeholders, a lack of universal vocabulary, and incomplete and changing requirements.

Even professional software engineers who are effective communicators do not have practice in articulating what makes communication effective (or ineffective). A major obstacle is a lack of a common language for discussing the specialized forms of communication taking place in software teams and between developers and other stakeholders. Through ethnographic studies of student teams and professional developers, Wallace is building a body of knowledge on communication practices. Ethnography looks at cultures from an insider perspective. Wallace’s colleagues in computer science and humanities, working as ethnographers, provided insider studies that reveal how communication practices are established and evolve over time. They are deriving patterns of effective practices—patterns that can be replicated time and again, in a variety of settings. In addition to contributing to the software development community’s library of patterns, Wallace and his colleagues are bringing the notion of communication pattern back to computer science students, helping them understand and analyze team software development.
Visualizing a Bright Future for Computer Science Education

Visualization is a process of presenting data and algorithms using graphics and animations to help people understand or see the inner workings. It’s the work of Ching-Kuang “CK” Shene. “It’s very fascinating work,” Shene says. “The goal is to make all hidden facts visible.”

All 10 of Shene’s National Science Foundation-funded projects center on geometry, computer graphics, and visualization. Together with colleagues from Michigan Tech, he’s transferring the unseen world of visualization into the classroom. Shene helps students and professionals learn the algorithm—the step-by-step formula—of software through visualization tools. His tools offer a demo mode so teachers can present an animation of the procedure to their class; a practice mode for learners to try an exercise; and a quiz mode to assess mastery of the concept. Tools Shene has implemented at Michigan Tech and the world over include DesignMentor for Bézier, B-Spline, and NURBS curve and surface design; ThreadMentor—visualization for multi-thread execution and synchronization—and CryptoMentor, a set of six tools to visualize cryptographic algorithms. Shene and Associate Professor of Computer Science Jean Mayo are collaborating on two new tools—Access Control and VACCS. He hopes his lifetime of visualization work helps advance the field of computer science: “My goal is to visualize everything in computer science.”
Ching-Kuang Shene

PROFESSOR, COMPUTER SCIENCE

EXPERTISE

- Geometric/solid modeling
- Computer-aided geometric design
- Visualization
- Computer science education

Ching-Kuang Shene earned his master’s and PhD in Computer Science from Johns Hopkins University. The 10-time National Science Foundation grantee and former mathematician and statistician currently works with Michigan Tech colleagues to apply visualization techniques to security issues in education.

In recent years, Shene concentrates on developing visualization tools for students and faculty to learn and teach curve and surface design, multithreaded programming and synchronization, cryptography, access control, and secure programming. He served as a National Science Foundation proposal panelist twice and was guest editor of Computer Science Education.

Shene’s Chinese photography blog on the history and technology of cameras, lenses, and lens-optics has more than 176 million page hits since 2008.

“Shene helps students and professionals learn the algorithm—the step-by-step formula—of software through visualization tools.”
Myounghoon Jeon

ASSOCIATE PROFESSOR, COMPUTER SCIENCE
ASSOCIATE PROFESSOR, COGNITIVE AND LEARNING SCIENCES
DIRECTOR, CENTER FOR CYBER-HUMAN SYSTEMS
DIRECTOR, MIND MUSIC MACHINE LAB

EXPERTISE
- Human-computer interaction/human-robot interaction
- Affective computing/emotional design
- Automotive user interfaces
- Assistive technology for special populations
- Aesthetic computing/media art

Myounghoon “Philart” Jeon studied at Georgia Institute of Technology, earning his MS in Engineering Psychology and PhD in Engineering Psychology and Human-Computer Interaction. The director of the Center for Cyber-Human Systems in the Institute of Computing and Cybersystems at Michigan Tech also serves as chairperson of the Affective Design Technical Committee of the International Ergonomics Association.

Jeon serves as associate editor of the MIT Press Journal Presence and has been published in more than 120 peer-reviewed publications. In addition to collaborations with Toyota, Hyundai-Kia Motors, General Electric, and Samsung, Jeon’s work has been supported by the National Institute of Health, the US Department of Transportation, the Michigan Department of Transportation, and the Michigan Tech Transportation Institute.

Jeon also oversees the Mind Music Machine Lab (tri-M) at Michigan Tech, a transdisciplinary research group studying how the human mind interacts with technology.

Research projects include:
- Performing arts and dancer-sonification in the immersive virtual environment
- Driver behavior in electric vehicles on the wireless recharging lane
- Emotion detection and regulation interfaces for drivers
- Auditory display design for digital devices
- Assistive technologies for the blind and older adults
- Social robots for children with autism
- Brain-computer interfaces
- Intuitive in-vehicle auditory interactions
- Sonically enhanced in-vehicle gesture interactions
- Driving data sonification for fuel efficiency
- Grade-crossing warning designs
Cognitive science is a relatively new interdisciplinary field weaving neuroscience, psychology, linguistics, anthropology, and philosophy with computer science. Cognitive scientist Myounghoon “Philart” Jeon, whose nickname translates to “love art,” studies how the human mind reacts to technology. Inside a unique research lab at Michigan Tech, Philart teaches digital devices how to recognize and react to human emotion.

**Art Meets Technology**

Humans respond to technology, but can technology respond to humans? That’s the goal of the Mind Music Machine Lab. Together with Computer Science and Human Factors students, Philart looks at both physical and internal states of artists at work. He asks: What goes on in an artist’s brain while making art?

Reflective tracking markers are attached to performance artists—which have included dancers, visual artists, robots, and even puppies—and 12 infrared cameras visualize and sonify their movement. From the movements, the immersive Interactive Sonification Platform (iSoP) detects four primary emotions: happy, sad, angry, and content. The result is a system that recognizes movement and emotion to generate real-time music and art.
Robotic Friends for Kids with Autism

Just as technology may not pick up subtle emotional cues, children with autism spectrum disorder (ASD) have difficulties in social interaction, verbal, and nonverbal communication. In this National Institutes of Health-funded project, Jeon uses technology in the form of interactive robots to provide feedback and stimuli to children with ASD. Studies indicate autistic children prefer simplistic animals and robots to complex humans. “These children have difficulty expressing emotions. And robots can help express and read emotion,” he says. Robots are programmed to say phrases with different emotional inflections. Cameras and Microsoft Kinect detect facial expressions of humans and use sound cues to reinforce what an emotion is. All the while, parents and clinicians monitor the interaction between the child and robot.

“ These children have difficulty expressing emotions. Robots can help express and read emotion.”
Min Song

DAVE HOUSE PROFESSOR AND DEPARTMENT CHAIR, COMPUTER SCIENCE PROFESSOR, ELECTRICAL AND COMPUTER ENGINEERING FOUNDING DIRECTOR, INSTITUTE OF COMPUTING AND CYBERSYSTEMS

EXPERTISE

- Wireless networking and systems
- Sensor networks
- Network security
- Cyber-physical systems
- Mobile computing

Prior to joining Michigan Tech in 2015, Min Song served as a program director for the National Science Foundation. He received the prestigious NSF Director’s Award for Collaborative Integration for the successful launch of groundbreaking international initiatives.

Song provided oversight for more than $80 million in education and research funding during his 26-year career spanning industry, academia, and government. His own work has yielded more than $3.4 million in funding by NSF, the Department of Education, NASA, and private foundations.

The NSF CAREER award winner has published more than 160 technical papers in addition to launching two international journals where he also served as editor-in-chief. He also served as editor or guest editor of 14 international journals, and as chairperson of INFOCOM 2016 and vice-chairperson of GLOBECOM 2015.

Song currently serves as the Communications Society Director of Conference Operations for the Institute of Electrical and Electronics Engineers.
Vehicle networks play an increasingly important role in promoting mobile applications, driving safety, network economy, and daily life. It is predicted there will be more than 50 million self-driving cars on the road by 2035; the sheer number and density of vehicles mean non-negligible resources for computing and communication in vehicular environments.

“It is important to develop a better understanding of the fundamental properties of connected vehicle networks and to create better models and protocols for optimal network performance,” Song explains.

Equipped with a $221,797 NSF grant, Song is collaborating with Wenye Wang of North Carolina State University on “The Ontology of Inter-Vehicle Networking with Spatial-Temporal Correlation and Spectrum Cognition.” The pair are investigating the fundamental understanding and challenges of inter-vehicle networking, including foundation and constraints in practice that enable networks to achieve performance limits.

Vehicular communications are driven by the demands and enforcement of intelligent transportation system and standardization activities on DSRC and IEEE 802.11p/WAVE. Many applications, either time-sensitive or delay-tolerant, have been proposed and explored, including cooperative traffic monitoring and control, and recently extended for blind crossing, collision prevention, real-time detour routes computation, and many others. With the popularity of smart mobile devices, there is also an explosion of mobile applications in terrestrial navigation, mobile games, and social networking through Apple’s App Store, Google Play, and Windows.

A systematic investigation of connected vehicles will be done to gain scientific understanding and engineering guidelines critical to achieving optimal performance and desirable services. The merit of the project centers on the development of theoretical and practical foundations for services using inter-vehicle networks. The project starts from the formation of cognitive communication networks and moves on to the coverage of messages. The project further studies how resilient a network is under network...
dynamics, including vehicular movements, message dissemination, and routing schemes. The impact of the research is timely yet long-term, from fully realistic setting of channel modeling, to much-needed applications in vehicular environments, and to transforming performance analysis and protocol design for distributed, dynamic, and mobile systems. The outcome will advance knowledge and understanding not only in the field of vehicular networks, but also mobile ad-hoc networks, cognitive radio networks, wireless sensor networks, and future 5G networks.

**High-Performance Wireless Mesh Networks**

A wireless mesh network is a network topology in which each wireless node cooperatively relays data for the network. Song’s CAREER Award project developed distributed interference-aware broadcasting protocols for wireless mesh networks to achieve 100 percent reliability, low broadcasting latency, and high throughput. The problem of network wide broadcasting is a fundamental operation in ad-hoc mesh networks. Many broadcasting protocols have been developed for wireless ad-hoc networks with different focuses. However, these protocols assume a single-radio, single-channel, and single-rate network model and/or a generalized physical model and do not take into account the impact of interference. This project focuses on the design, analysis, and implementation of distributed broadcasting protocols for multi-radio, multi-channel, and multi-rate ad-hoc mesh networks.

Song’s work advances knowledge and understanding in the areas of wireless mesh networks, network optimization, information dissemination, and network performance analysis. Research findings allow the research community and network service providers to better understand the technical implications of heterogeneous networking technologies and cross-layer protocol support, and to create new technology needed for building future wireless mesh networks. The problems studied are pragmatically and intellectually important and the solutions are critical to several areas such as modeling of wireless communication links, system performance analysis, and algorithms.
MAKING DATA RETRIEVAL MORE EFFICIENT

When a user performs a search in social media, the request doesn’t stay within that platform. It calls upon the resources of a data center. “When someone sends a request to a data center, they want an immediate answer—they don’t want to wait,” Zhenlin Wang explains.

Together with colleagues from Peking University, the University of Rochester, Wayne State University, and Michigan Tech, Wang looked to improve the internal structure, theory, and algorithm of memory cache to make it more efficient. This work is an offspring of his 2007 CAREER award.

“Currently, bulky disks store the data and are slow to react. When smaller, in-memory cache is used, the search is much faster,” he adds. “We designed upon open-source software and memcached that was adopted by Facebook and Twitter. They modified their approach to adapt to user demand. Our method beats their current practices,” Wang says.

“Imagine inviting 100 people over to your house for dinner, but only four will fit in your dining room. When we think about data resource management, it’s a similar scenario.”

“...open-source software and memcached that was adopted by Facebook and Twitter. They modified their approach to adapt to user demand. Our method beats their current practices.”
Zhenlin Wang

PROFESSOR, COMPUTER SCIENCE
PROGRAM DIRECTOR, COMPUTER SCIENCE GRADUATE STUDIES

EXPERTISE
- Optimizing compilers
- High-performance architectures
- Cloud computing

Zhenlin Wang received his master’s in Computer Science from Peking University in China. He attended the University of Massachusetts Amherst for his PhD.

His research is in the areas of compilers, computer architecture, and operating systems with a concentration on memory-system optimization. One of his recent projects aims to minimize memory-virtualization overhead by exploring the advantages of both hardware and software memory-virtualization schemes, developing new memory allocators.

Wang was a National Science Foundation CAREER Award recipient for his proposal to unify prediction of both temporal and spatial reuses.
Vertanen’s research will offer more texting options not only to the blind community, but to the situationally impaired, too.

ADVANCEMENTS IN EYES-FREE TEXT ENTRY

For Keith Vertanen, the satisfaction of helping people with visual impairments is a byproduct of the challenge he seeks. “My interest stemmed from sighted text entry research. The decoder (a touchscreen keyboard recognizer) is so accurate—we craved a bigger undertaking,” Vertanen explains. So he dug into literature and consulted with users who are blind to determine the need for better eyes-free text-entry options.

Existing accessibility solutions are slow. “There is a delay because users have to search for the target, key, or graphic and wait for audio feedback,” Vertanen says. By sliding a finger around on the touchscreen, the system announces via text-to-speech what their finger is over. When they find the element they want (it could be a key on a touchscreen keyboard), they double tap with their searching finger or they “split tap” by tapping with a second finger. The interaction technique was developed out of research at the University of Washington and is now a standard accessibility feature on iPhone and Android phones.

With Vertanen’s prototype, users with visual impairments imagine the size, position, and orientation of the Qwerty keyboard. They are asked to tap out letters, and eventually sentences. So far, users accurately tap their intended text on the imaginary display about 50 percent of the time. There’s more work to be done. From this noisy data, Vertanen asks two questions: Can we develop new and improved algorithms to more accurately recognize the user’s intended text? And can we find ways users can provide the recognizer with a better signal while still allowing fast entry?

Vertanen’s research will offer more texting options not only to the blind community, but to the situationally impaired, too: “Those times when you cannot attend to your phone, like when you’re walking. Or perhaps we can treat your airline tray table as a touch-typing surface—but without a visual display.”

His research will also impact the devices of the future which may be designed without a text display. “These are hard problems to solve. The other challenge is how to make error-correction efficient and pleasant. This is especially true if people are entering difficult text such as proper names or acronyms. A complementary approach is, how do you design text-entry interfaces that allow users to be more explicit (albeit slower) about parts of their text they anticipate will be difficult to recognize,” Vertanen asks.
Keith Vertanen

ASSISTANT PROFESSOR, COMPUTER SCIENCE

EXPERTISE

- Human-computer interaction
- Speech and language processing
- Mobile interfaces
- Crowdsourcing

Keith Vertanen holds a master’s from Oregon State, and an MPhil and PhD from the University of Cambridge. He is a Google Research Award recipient for the project “Less is More: Investigating Abbreviated Text Input via a Game.” Vertanen’s other work includes Parakeet, a speech recognition system for mobile touch-screen devices; Speech Dasher, an interface for fast text entry combining speech and eye gaze; and VelcoITap, a sentence-based touchscreen keyboard decoder.

Vertanen is the associate editor of the International Journal for Human-Computer Studies, vice president for Speech and Language Processing for Assistive Technologies, and is co-organizing the CHI 2016 workshop on Inviscid Text Entry and Beyond in San Jose, California.

Vertanen’s father, three uncles, and three cousins are Michigan Tech Alumni.

Gamifying Data Collection

Just about every researcher understands how difficult and expensive it is to accumulate data. Keith Vertanen’s solution: gamify it. As part of his Google Research Award, sighted gamers play his custom text adventure demo. The information is collected and used as surrogate data for his assistive technology research.
Leo Ureel
LECTURER, COMPUTER SCIENCE
COORDINATOR, COMPUTER SCIENCE LEARNING CENTER

EXPERTISE
■ Software engineering
■ Computer science education
■ Intelligent learning environments

Leo Ureel earned his BS and MS in Computer Science from Michigan Technological University. He brings nearly three decades of industry experience as a software engineer into the classroom. In addition to teaching introductory computer science courses at Michigan Tech, Ureel has been integral in redeveloping the curriculum from a lecture-based program to an exploration model. He also leads the Computer Science Learning Center, working with undergraduate peer coaches to tutor other students.

Grants from Google and National Science Foundation Cyberlearning support Ureel to prepare students to become agile communicators and provide outreach to future STEM students in middle and high schools.

Ureel’s digital literacy work with local senior citizens has been highlighted at the International Conference on Pervasive Technologies in Rhodes, Greece. His work with automated iterative critique of student programming assignments has appeared in the Proceedings of the Frontiers in Education.
STUDENT SUCCESS IN COMPUTER SCIENCE

Redeveloping Michigan Tech’s introductory computer science courses has not been an easy feat. But for Leo Ureel, it’s meaningful work. “It’s about setting the right environment,” he says.

In the old model, instructors lectured, then assigned independent tasks. Teaching assistants graded the projects and returned them to students two or three weeks later. In a new model Ureel helped create, students work in groups of two to four to mimic workforce settings. “We are no longer just feeding information. Humans learn best when we communicate with others. We’ve taken what we know works in industry and applied it to the classroom,” Ureel explains.

With support from a Jackson Blended Learning Grant, Ureel implemented a web-based teaching assistant to tighten the feedback loop for students. Students submit code via a web portal and receive instant feedback. “They continue submitting work until they get it right. It’s mastery learning,” Ureel adds.

Authentic Learning Experiences

When first-year Michigan Tech student Lauren Brindley received a Google Ignite Computer Science grant to provide funding for 10 robots, Ureel knew it was an opportunity to provide a rich learning experience for students. “After graduation, it’s likely students will build robots in their careers; we’re providing real-world, hands-on learning from day one.” Ureel is developing inquiry curriculum where first-year computer science students will explore how to program the rover robots to move about the room.

Ureel’s next challenge is to assess each first-year student to ensure they’re in the proper course. “Nonmajors often come in with little to no programming experience; meanwhile computer science majors are off and running, ready for a challenge,” Ureel says. To help several hundred students determine the best courses, Ureel is creating an online course sample so students get a taste of course content before making any decisions. Preliminary data indicates Ureel’s efforts are working. “Engagement, retention, and grades are improving.”
THE MAKING OF A CITIZEN SCIENCE APP

Astronomy is a citizen’s science. Its foundation is ordinary people who help answer serious scientific questions by providing vital data to the astronomical community. Nebulas, supernovas, and gamma ray sightings.

These days former astronomy teacher Robert Pastel isn’t as interested in the stars, but he is serious about environmental science and using computer science—and smartphones—to capture more data from citizen scientists.

The availability of smartphones make collecting and sharing scientific data easier, faster, and more accurate. Pastel works with Alex Mayer, professor of civil and environmental engineering at Michigan Tech, students in both computer science and humanities, and scientists around the world to build mobile apps that feed real-world projects.

It starts in the summer, with scientists. “We reach out to them, or they find us. They share an idea and how citizen science can be used,” Pastel explains. “Then the app building begins; it’s about a two-year process.”

When the academic year rolls around, Pastel challenges his Human-Computer Interactions class to build the initial app prototype. In the following year, during Pastel’s Senior Design course, the app undergoes a makeover—from mobile app to a web-based tool. “By this time the scientists have likely changed their minds or solidified their ideas, and more changes are made,” Pastel adds.

An interactive mushroom mapper is the group’s most successful accomplishment to date. Hikers, bikers, or climbers—anyone with a smartphone and an affinity for fungi—capture a photo of the fungus, specify the type, describe the location, and hit submit. All via the app. The mushroom observation data reaches Eric Lilleskoz, a research ecologist with the United States Department of Agriculture. Mushroom Mapper has more than 250 observations from around the country. The app is also used for natural science education in local middle schools.

In addition to creating apps for citizen science, this NSF-supported effort has spawned student-initiated software development and offline apps.
Robert Pastel
ASSOCIATE PROFESSOR, COMPUTER SCIENCE
AFFILIATED ASSOCIATE PROFESSOR, COGNITIVE AND LEARNING SCIENCES
FACULTY ADVISOR, HUMANE INTERFACE DESIGN ENTERPRISE

EXPERTISE
■ Mobile app design and usability
■ Software development and processes
■ Computer science education

Robert Pastel holds a master’s in Engineering Science from the University of Tennessee, a master’s degree in Computer Science from Michigan Tech, and a PhD in physics from the University of New Mexico. With his spectrum of expertise, Pastel collaborates with colleagues, researchers, and students in humanities, business, forestry, and many other disciplines.

As the faculty advisor for the Humane Interface Design Enterprise, Pastel helps students design, develop, and evaluate interfaces to make daily work more efficient and manageable. The group is building a driver simulator and evaluating Chrysler’s U-connect radio and display—a touchscreen found in luxury cars.

Pastel is also the project manager of Mobile Environmental Citizen Science at Michigan Tech.

“
The availability of smartphones make collecting and sharing scientific data easier, faster, and more accurate.

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MICHIGAN TECHNOLOGICAL UNIVERSITY 35
Linda Ott

PROFESSOR, COMPUTER SCIENCE
ASSOCIATE DEAN FOR SPECIAL INITIATIVES, COLLEGES OF SCIENCES AND ARTS

EXPERTISE
- Software measurement
- Software processes
- Software engineering education
- Women in computing
- Undergraduate retention

Linda Ott was the third female to earn a PhD in Computer Science from Purdue University, where she also obtained her master’s degree. She served as chairperson of the Michigan Tech Department of Computer Science from 1996 to 2010.

Ott was the 2010 recipient of the SIGSOFT (Special Interest Group on Software Engineering) Retrospective Paper Award and has helped secure $1.5 million in grants from industry and the National Science Foundation. The Fulbright Scholar taught advanced software engineering at Siberian State Aerospace University in Krasnoyarsk, Russia, and ethical and social aspects of computing at Beijing Normal University in Zhuhai, China.

She is a founding organizer of the Michigan Celebration of Women in Computing and of the National Center for Women and Information Technology (NCWIT) Aspirations in Computing Michigan Affiliate Award for high school women. She is also the project leader for Michigan Tech’s NCWIT Extension Services for Undergraduate Programs team. Ott also helps organize the Women in Computing Day.

In 2014, Michigan Tech honored Ott with the inaugural Diversity Award.

“Computer science is no longer lone individuals sitting in a dark room on a computer. It’s vibrant, team-based, and a lot more fun.”
CREATING OPPORTUNITIES FOR WOMEN IN COMPUTING

For Linda Ott, debugging a program is like solving a mystery. “We don’t tell girls about computing when they’re young, so they don’t see how fun computing can be,” Ott explains. “They hear about biology and chemistry, but computing seems abstract.” And very few middle and high schools have computing courses or instructors. “Girls don’t see role models,” she adds.

Ott studied computer science at Purdue University in the 1970s—a time when there were few other female computing scholars. At Michigan Tech, she is devoted to giving more women the opportunity to discover computing.

Ott observes that when girls do have the chance to program—to create something out of nothing—they often really enjoy the experience. “It’s problem solving. They get to express ideas by writing code.”

With a grant from the Jackson National Life Insurance Company, in 2014 Ott helped restart the Women in Computer Science Summer Program. She is integral in the fundraising, curriculum, instruction, and coordination of the weeklong program that offers 36 girls from Michigan, Minnesota, Wisconsin, Illinois, North Carolina, and Pennsylvania the chance to discover computer science.

Through the National Center for Women and Information Technology Pacesetters, Ott works with a cohort of academic and industry professionals who are committed to dedicating resources, brainstorming, and marketing to recruit more women into the computing fields. “There’s a spectrum of possibilities for women in computing—they may work in the user experience end or be involved as a project manager,” Ott says.

Through her work with students, Ott observes that typical computer science job descriptions are obsolete and career assessments can be misleading. “Women might not enter this field because an assessment directs them to other areas. What they don’t realize is the wide array of skills useful in this field.” She has convinced NCWIT to take a look at this problem—and to reevaluate career assessments, too.

“Computer science is no longer lone individuals sitting in a dark room on a computer. It’s vibrant, team-based, and a lot more fun.”
The road above has no forks, nor is it fog-covered, but you still can’t predict what lies ahead. Making decisions under uncertainty involves more than being presented with multiple options and choosing the best one. The problem is much more complex because the forks and options are not readily seen.

Inevitably, plans go wrong. Plans for robots and plans for humans. It’s impossible to predict all the ways plans may go wrong—or how to fix them. Nilufer Onder works to create algorithms to address and fix plans—from construction management to the Mars rover and microarchitecture. Her research spans interdisciplinary areas where uncertainty is prevalent.

**Simulator Verification: Searching for a Base Truth**
Simulators are large, complex pieces of code. Simulation developers continually modify the code to adapt to ever-changing technology. Onder and her team from Michigan Tech, including Zhenlin Wang and Soner Onder, developed a graphical structure to automatically derive verification constraints from simulator traces. SFTAGs (state-flow temporal analysis graphs) take into account stochastic paths and durations taken by events that are being simulated.

**Constructing Parallel Plans**
Automatic generation of robust plans that operate in realistic domains involves reasoning under uncertainty, operating under time and resource constraints, and finding the optimal set of goals to work on. Creating plans that consider all of these features is a computationally complex problem addressed with the planner CPOAO (concurrent probabilistic oversubscribed planning using AO). CPOAO includes novel domain independent heuristics and pruning techniques to reduce the search space.

**Risk-Informed Project Management**
The construction industry is the largest single production activity in the US economy—accounting for nearly 10 percent of the gross national product. Contingencies commonly cause delays and added costs in construction projects. Onder’s work involves providing automated techniques to avoid and respond to contingencies.
Together with Amlan Mukherjee, a researcher in civil and environmental engineering at Michigan Tech, Onder created a learning environment for construction management students to predict and address change. “Students take a construction plan and overlay it with events that cause delays. Then we ask students to react to the scenarios,” she explains.

Onder’s team developed ICDMA (interactive construction decision-making aid) which uses AI-planning technology to predict the paths a project can take.

**Student Persistence in Engineering and Computer Science**
Careers in engineering and computer science usually promise a well-paying and respected job. However, approximately 55 percent of US students leave these fields within six years, choosing a non-STEM field or leaving higher education altogether. Onder’s group investigates the complex issues surrounding student persistence, including who influences career choices, what factors affect changing majors, and the under-representation issues involved in staying in a major.
Nilufer Onder

ASSOCIATE PROFESSOR, COMPUTER SCIENCE

EXPERTISE

- Artificial intelligence
- Automated planning and scheduling
- Computer science education
- Student persistence in STEM

Nilufer Onder earned her master’s in Computer Engineering from Middle East Technical University and a PhD in Computer Science from the University of Pittsburgh.

Her research is in artificial intelligence planning systems and decision-making under uncertainty. Her applied research is in risk-informed project management, micro-architecture simulator verification, and evolutionary algorithms for space trajectories.

Onder serves as the advisor of the Upsilon Pi Epsilon Computer Science Honor Society, co-advisor of Women in Computing Sciences, founding advisor of the student chapter of the Association of Computing Machinery, co-director of WISE (Women in Science and Engineering), and a founding co-advisor of the Turkish Student Association. Every Saturday since 2005 Onder serves as a Science Olympiad Coach at an area middle and high school.

She was a 2013 recipient of the Distinguished Teaching Award for her contribution to instruction at Michigan Tech, connecting what students learn in the classroom to how they’ll apply it in the future.
Saeid Nooshabadi

PROFESSOR, COMPUTER SCIENCE
PROFESSOR, ELECTRICAL AND COMPUTER ENGINEERING
FOUNDING DIRECTOR, CENTER FOR COMPUTER SYSTEMS RESEARCH

EXPERTISE

- High-performance computer architecture
- Embedded systems
- Multimedia system design
- High-performance and low-power computing systems
- Information-processing systems
- Embedded electronic systems

Saeid Nooshabadi received an MTech and a PhD in Electrical Engineering from the Indian Institute of Technology, Delhi. He is jointly appointed as a professor of high-performance computer architecture, embedded systems, and VLSI signal processing in the Department of Electrical and Computer Engineering and the Department of Computer Science. Nooshabadi has extensive experience and interest in the area of SoC design of multimedia systems, high-performance and low-power computing systems, application-specific integrated circuit design for information-processing systems, and embedded electronic systems.

He was a professor in the Department of Information and Communications at the Gwangju Institute of Science and Technology in the Republic of Korea, and was with the School of Electrical Engineering and Telecommunications at the University of New South Wales in Sydney, Australia, where he currently holds an adjunct appointment.

He was a visiting faculty member and researcher in Western Australia’s Center for Very High-Speed Microelectronic Systems of Edith Cowan University and Curtin University of Technology. He also worked as a research scientist in the CAD Laboratory of the Indian Institute of Science in Bangalore.

Nooshabadi is coauthor of multiple patents, more than 150 technical journals, and award-winning conference papers on VLSI information processing.
When you view a YouTube video, you are viewing tens of gigabytes compressed up to 50 times. The process to transmit what an HD camera captures requires large quantities of frame-by-frame video data transmission—and such is the case in sports broadcasting—it must happen fast.

“We can take advantage of similarities of each frame to reduce the size of the transmissions,” Nooshabadi says. In the case of sports, where video is captured from multiple angles, computer scientists can reconstruct missing coverage using free-view video technology. “The more cameras recording—the better,” he adds. Computational complexity is high because sports coverage is real-time.

Applications of Nooshabadi’s multi-view video processing work, funded by the National Science Foundation, include not only sports reporting, but surveillance and even remote surgery.

When your smartphone captures photos in burst mode, capturing a photo every half-second, each image is ever-so-slightly different. The images can be combined, stacked, and processed using complex mathematical operations to enhance the quality. This technology is useful in consumer-imaging devices.

“One of my students is working with the Donald Danforth Plant Science Center to apply image registration techniques to phenotyping applications. The technique requires referencing data from multiple sensors to the same spatial location, so data from multiple sensors can be integrated and analyzed to extract useful information,” Nooshabadi says.

“Previously these technologies required supercomputers. Now with advancements in mobile digital devices, the technology is becoming faster and more accessible.”
IMPROVING CYBER SECURITY—EDUCATION AND APPLICATION

Most cyber attacks aren’t new. Rather, they are new to the administrators encountering them. “The workforce isn’t well trained in these complex issues,” Jean Mayo explains. “One problem we encounter in education is that we cannot allow students to modify the software that controls an actual system—they can cause real damage.”

With support from the National Science Foundation, a team of Michigan Tech computer scientists teaches modern models of access control using visualization systems within user-level software. Mayo and her team are also taking a fresh look at teaching students how to code securely. “The system we developed will detect when security is compromised and provide students with an explanation of what went wrong and how to fix it,” she adds.

**File System Enhancement for Emerging Computer System Concerns**

Mayo is applying existing firewall technology to file system access control. In her core research, she’s providing greater flexibility for administrators to determine when access is granted. “Using the firewall model to filter traffic content—like a guard standing by a door—we can add more variables to control file access, like time of day or location. It is more flexible, but also more complex—firewalls are familiar and help administrators navigate the complexity.”

Mayo is also developing a language for guaranteeing file security. “Our goal is to keep the data safe not only by controlling who has access, but by ensuring file integrity.” This system will disallow changes made to a file when the change doesn’t meet file specifications. “This helps to prevent users from entering incorrect data.”

Our goal is to keep the data safe not only by controlling who has access, but by ensuring file integrity.
Jean Mayo
ASSOCIATE PROFESSOR, COMPUTER SCIENCE

EXPERTISE
- Distributed systems
- Operating systems
- Security
- Computer science education

After working as a mechanical engineer developing real-time simulations and control systems for Newport News Shipbuilding, Jean Mayo earned her master's and PhD in Computer Science from the College of William and Mary. During her graduate studies, Mayo led computer science courses and worked as a researcher for ICASE at NASA Langley.

Mayo became a National Science Foundation CAREER Award recipient for “Development and Control of Distributed Computations in a Global Time Frame.” Her projects “Accessible Access Control” and “VACCS: Visualization and Access Control for C Code Security” have also been supported by NSF.

She applies her real-world experience teaching undergraduate and graduate-level courses in discrete mathematics, formal models of computation, systems programming, operating systems, computer security, and distributed systems.
Stéphane Zuckerman

VISITING ASSISTANT PROFESSOR, COMPUTER SCIENCE

EXPERTISE

- High-performance computing
- Parallel computing

Stéphane Zuckerman obtained his PhD in Computer Science from the University of Versailles, France, where he studied the memory subsystems of various multiprocessor, multicore shared memory systems, and how to best remove bottlenecks in various real-life applications—ranging from heat transfer modeling in car-engine casts, to material deformation in industrial furnaces.

Zuckerman’s research interests focus on high-performance computing. This encompasses the design and specification of novel program execution models for future extreme-scale supercomputers, event-driven multithreading, compiler technology for parallel computing, runtime system design and implementation, fine-grain resource management, as well as performance assessment, profiling, and optimization of real-life applications and computation kernels.

As a research associate in the Computer Architecture and Parallel Systems Laboratory at the University of Delaware, Zuckerman helped specify a novel execution model for future extreme-scale supercomputers. He also helped design and implement a runtime system implementing the Codelet Model, and a fine-grain resource management simulator designed to allow computers to self-adapt according to introspection mechanisms in future general purpose many-core systems.

In 2016, Zuckerman joined Michigan Tech’s Department of Computer Science as a visiting professor.
Ubiquitous High-Performance Computing (UHPC) and X-Stack Projects

The Ubiquitous High-Performance Computing Project, funded by the Defense Advanced Research Projects Agency (DARPA), initiates research on energy-efficient, resilient, and many-core computing on the horizon for 2018. Faced with the end of Dennard scaling, it was imperative to provide better hardware and software to face energy consumption of future computers, but also to exploit a large number of cores in a single cabinet (up to $10^{15}$ floating-point operations per second), all the while consuming no more than 50kW. A thousand of those machines have the potential to reach one exaflop ($10^{15}$ floating-point operations per second). The hardware should expose several “knobs” to the software, to allow applications to gracefully adapt to a very dynamic environment, and expand and/or contract parallelism depending on various constraints such as maximal authorized power envelope, desired energy-efficiency, and required minimal performance.

Following UHPC, the Department of Energy-funded X-Stack Software Research project recentered the objectives. By using traditional high-performance communication libraries such as the Message-Passing Interface (MPI), by revolutionizing both hardware and software at the compute-node level.

In both cases, it was deemed unlikely that traditional programming and execution models would be able to deal with novel hardware. Taking advantage of the parallelism offered by the target strawman hardware platform would be impossible without new system software components. The Codelet Model was then implemented in various runtime systems, and inspired the Intel-led X-Stack project to define the Open Community Runtime (OCR). The Codelet Model was used on various architectures, from the IBM Cyclops-64 general-purpose many-core processor, to regular x86 compute nodes, as well as the Intel strawman architecture, Traileika Glacier. Depending on the implementations, codelet-based runtime systems run on shared-memory or distributed systems. They showed their potential on both classical scientific workloads based on linear algebra, and more recent (and irregular) ones such as graph-related parallel breadth-first search. To achieve good results, hierarchical parallelism and specific task-scheduling strategies were needed.

Self-awareness is a combination of introspection and adaptation mechanisms. Introspection is used to determine the health of the system, while adaptation changes parameters of the system so parts of the compute node consume less energy, shutdown processing units, etc. Introspection and adaptation are driven by high-level goals expressed by the user, related to power and energy consumption, performance, and resilience. The team studied how to perform fine-grain resource management to achieve self-awareness using codelets, and built a self-aware simulation tool to evaluate the benefits of various adaptive strategies.

The TERAFLUX Project

The TERAFLUX project was funded by the European Union. It targeted so-called “teradevices,” devices featuring more than 1,000 cores on a single chip, but with an architecture that will make it near-impossible to exploit using traditional programming and execution models. DF-Threads, a novel execution model based on dataflow principles was proposed to exploit such devices. A simulation infrastructure was used to demonstrate the potential of such a solution, while remaining programmable. At the same time, it was important to maintain a certain level of compatibility with existing systems and features expected by application programmers. Both models borrow from dataflow models of computation, but they each feature subtle differences requiring special care to bridge them. Zuckerman and his colleagues ported DARTS—their implementation of the Codelet Model—to the TERAFLUX simulator, and showed a convergence path existed between DF-Thread and codelet-execution models. The research demonstrated the advantages of hardware-based, software-controlled multithreading with hardware scheduling units for scalability and performance.

Stéphane Zuckerman presented the results and outcomes of his research in peer-reviewed conferences and workshops.
Ali Ebnenasir

ASSOCIATE PROFESSOR, COMPUTER SCIENCE

EXPERTISE
- Software engineering
- Automated analysis of fault-tolerance
- Formal methods

Ali Ebnenasir completed his ME in Software Engineering from Iran University of Science and Technology. He earned his PhD in Computer Science from Michigan State University. He was awarded an Institute of Electrical and Electronics Engineers (IEEE) Computer Society Travel grant and was nominated for the Association for Computing Machinery (ACM) Doctoral Dissertation Award.

His research and teaching interests include software engineering, formal methods for software development, high assurance and dependable computing, parallel and distributed computing, and mission-critical embedded systems.

SELF-STABILIZING SYSTEMS

It was August 15, 2003. A software bug invoked a blackout spanning the Northeast, Midwest, and parts of Canada. Subways shut down. Hospital patients suffered in stifling heat. And police evacuated people trapped in elevators.

What should have been a manageable, local blackout cascaded into widespread distress on the electric grid. A lack of alarm left operators unaware of the need to re-distribute power after overloaded transmission lines hit unpruned foliage, which triggered a race condition in the control software.*

Ali Ebnenasir is working to prevent another Northeast Blackout. He’s creating and testing new design methods for more dependable software in the presence of unanticipated environmental and internal faults. “What software does or doesn’t do is critical,” Ebnenasir explains.

“Think about medical devices controlled by software. Patient lives are at stake when there’s a software malfunction.”

How do you make distributed software more dependable? In the case of a single machine—like a smartphone—it’s easy. Just hit reset. But for a network, there is no centralized reset. “Our challenge is to design distributed software systems that automatically recover from unanticipated events,” Ebnenasir says.

The problem—and some solutions—has been around for nearly 40 years, but no uniform theory for designing self-stabilizing systems exists. “Now we’re equipping software engineers with tools and methods to design systems that autonomously recover.”

Ebnenasir’s work has been funded by the National Science Foundation.

Kim Tracy
LECTURER

EXPERTISE
- Computer security
- Artificial intelligence
- Software intelligence
- Data systems

Kim Tracy received his master’s from Stanford and is an expert in computer security, artificial intelligence, and data systems. He draws upon his extensive background in teaching systems development in the Bell Labs division of Lucent Technologies to enhance courses for his students. Currently serving a five-year term on the Computing Accreditation Commission, Tracy is active in documenting the scientific and educational history of computing.

Author of 2016’s *Software Evolution*, Tracy is a former editor-in-chief and current *IEEE Potentials* magazine editorial board member. He is also developer of the IEEE Mobile App, a project that resulted in prototypes for Apple iOS and Google Android native apps. Tracy is a senior member of the Association of Computing Machinery and the Institute of Electrical and Electronics Engineers.
Dave House
Dave House ’65 made a $10-million pledge to Michigan Tech’s Generations of Discovery capital campaign, the largest outright gift ever received by the University. Most of the contribution will come during his lifetime, including two recently established endowed professorships.
House is the volunteer chair of the University’s national fundraising campaign. His giving supports Tech’s strategic objective of becoming a world-class public research university.
“Increasing complexity in every field has driven the need for more advanced degrees, and Michigan Tech must meet that need,” House says. “A well-executed strategic plan will attract and retain the best faculty needed to propel Michigan Tech nationally into the top quadrant and better prepare tomorrow’s students for tomorrow’s world.”
He earned a BS in Electrical Engineering at Michigan Tech and was a longtime Intel executive.

Donn and Liza Schneider
Donn ’76 and Liza Schneider made an estate gift of $1 million for an endowed professorship in the Department of Computer Science. Donn Schneider was one of the first graduates majoring in computer science at Tech. The couple also gave an additional $500,000 to provide postdoctoral fellowship support.
Chair Min Song said that the ability to attract and retain the best faculty and students is key to the success of their mission. Permanently invested gifts from private donors help support competitive salaries, teaching technologies, and research.

ENDOWED SCHOLARSHIPS

Erick S. Dyke Endowed Scholarship
Honors the late Erick Dyke ’91, who triple-majored in computer science, computer engineering, and electrical engineering. After graduating, he co-founded n-Space, a highly successful video game development company in Orlando, Florida.

John and Sheri Stromp Endowed Scholarship
Recognizes undergraduate students with demonstrated financial need and scholastic achievement. Preference is given to students majoring in computer engineering, computer science, or software engineering. The scholarship may be awarded on a renewable basis for up to full in-state or out-of-state tuition.

Dr. John Lowther Endowed Scholarship
Honors John Lowther, the first computer science faculty member at Michigan Tech. Once the initial goal of $25,000 is reached, this fund will support students in computer science in perpetuity.
Honor Roll
Karla & James Aho
Kelly & Mark Allison
Sally & Craig Anderson
Penelope & Joel Anderson
Ian Anderson
Patricia & Marc Angell
Christine & Mark Armstrong
Lynn & Shawn Baranczyk
Louis Barea
Tammy & Robert Barnes
Rex Baumeister
Barbara Berg
Maureen & David Bhaskaran
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Lori & Richard Boes
Justin Brandel
Jacob Brodersen
Shannon Brodeur
Ann Marie & Mark Bukowski
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Ronda & Misak Dulsbandzhan
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John Enrich
Jon Ensminger
Michele & Robert Foguth
Kathryn & John Fowler
Cally & John Furton
Rebecca & Michael George
William Golden
Carolyn & Gerald Gornowicz
Joel Graber
LuAnne & Timothy Green
Jeffrey Haas
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House Family Foundation
Amy & Craig Hughes
Linda & Raymond Jasicki
Myounghoon Jeon
Laurel & Armin Johnson
Jarrod Karau
Maryann & Bruce Kavanagh
Kathy & Mark Keithly
Beth Kirschner
Donna & Robert Koopman
Renee Kovaless
David Kraus
Scott Kuhl
Karen & Erik Kukkonen
Kara Kyro
Lisa & Daryl Lahti
Monica & Kerry Langsford
Todd Larson
Melinda & Mark Lathrop
Xiang Li
Sandra & Jon Logan
Dawn & Russell Louks
Bruta & John Lowther
Luke Lussenden
Jun Ma
Karen & Douglas MacKenzie
Douglas Manley
Katherine & Gordon Manley
Patrick Marcell
Clayton Marriott
Dianne & Thomas Marsh
Michelle & Michael Martin
Jennifer & Stephen Martini
Mark Mathieu
Jean Mayo
Janet & John McDermott
Amy McDonald
Tara McKibben
Kathleen McLeod
Paul McMurphy
Michele & Michael McRae
Ravish & Bakul Mehta
Daniel Morgan
Catherine & Stephan Munsch
Sara Niemeyer
Saeid Nooshabadi
Brita & Jacob Northey
Jeffrey Nyquist
Nilufer & Soner Onder
Linda Ott
Kari & Michael Palmer
Kathleen & Dennis Parker
Robert Pastel
Margaret & Andrew Perrie
Dana Peters
Dennis Petrucci
La Donna & David Poplawski
Jessica & Christopher Pyhtila
Nathan Rabe
Carol & Bruce Reed
Vikki & John Richert
Susan Ringwall
John Roelandt
Joseph Ross
Fang & Fan Ruan
Claire & David Salac
Monica & Jeffrey Sandoval
Jeevan Savant
Lisa & Donn Schneider
Andy Schrage
Ching-Kuang & Su-Shen Shene
Rebecca & Nathan Skalsky
Min Song
Michelle Sorrow-Walters
Mary Ann & Michael Sprague
Margaret & Jon Steele
Vicki & Jan Stefan
Laura & Mark Stevens
Roma & Fred Strathman
Sheri & John Stevens
Nathan Teller
Joshua Thomason

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DONORS AND SCHOLARSHIPS

Supriya Uchil
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Susanna & Charles Wallace
Angela & Thomas Walter
Zhenlin & Ruihong Wang
Cameron Webb
Corinna & Philip Wells
Ann & Jeff West
Margaret & John Williams
Denice & Keith Winegar
Linda & Gary Wittbrodt
Roslyn & Dennis Wolbers
Lisa & Timothy Wysocki
Richard Zajac

CORPORATE AND INSTITUTIONAL DONORS

Association For Computing Machinery
Benevity Community Impact Fund
Caidan Management Company
Control-Tec
Epic Systems Corporation
Fidelity Charitable Gift Fund
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Jackson National Life Insurance Company
Meraki
National Center For Women & Information Technology
Target
Tides Foundation
Upper Peninsula Power Company

Ways you can support the Department of Computer Science at Michigan Tech

Department of Computer Science
Gifts made directly to the department are unrestricted, supporting both current priorities and emerging opportunities.

Scholarship Fund
Directly benefits undergraduate students who otherwise may not be able to attend Michigan Tech.

Graduate Fellowships/Scholarships
Enables us to attract graduate students passionate about computer science.

Building Fund
Keeping our facilities operating at peak performance is key in supporting world-class education and research.

To support computer science at Michigan Tech, please contact the Office of Gift Planning at giftplan@mtu.edu or 906-487-2310.
STUDENT ACTIVITIES

From testing nanosatellites to releasing Xbox games, Computer Science students know their real work is done outside the classroom. They take their knowledge and apply it through Enterprise, Design Expo, and Winter WonderHack. It’s solving tomorrow’s toughest computing challenges at the Husky level.

Enterprise

Enterprises are student-run business teams in engineering design, team building, project management, and end-to-end original product development. Under the direction of a faculty advisor, Computer Science students work on these Enterprise teams:

Blue Marble Security (BMS): This student-led company combines engineering design, team building, project management, and original product development. Projects include an autonomous robot built to compete in the Intelligent Ground Vehicle Competition, a simple heart-rate monitor for education and community outreach, and a portable blood-typing device. The enterprise also has two industry-sponsored projects involving metal fracture analysis and an employee resource-scheduling database.

Humane Interface Design: This team provides students an opportunity to design, develop, and evaluate interfaces to make daily work more efficient and easier to manage. The group is working on building a driver simulator and evaluating Chrysler’s U-connect radio and display.

Husky Game Development: The team designs and develops games for business, education, and fun, earning credit, gaining experience, and building their résumés while creating quality software that attracts industry sponsors. They foster productivity, creativity, and effective business practices. Members work in small teams of four to six people, exploring video game engines and platforms, including Windows, Android, Xbox, and an experimental Display Wall and 3-D motion-tracking system. The team also competes in a local 24-hour game development challenge, the Houghton Game Jam, and recently co-hosted BonzAI Brawl, an AI coding competition. One of the group’s games, Arcane Brawlers, was released on Xbox Marketplace.

IT Oxygen: This student-run business focuses on information system and information technology solutions. With expertise in systems and information analysis, software development, database design, and web-based application development, the group serves local and regional clients on an open-source donor-tracking system and a dashboard website that manages daily operations for a large-scale theater.

Open Source Hardware Enterprise: This group links high school, college, and professional organizations through the development of open-source hardware. The initial focus of the enterprise is to develop high-value products, like scientific equipment from rapid prototyping, and reuse waste materials, but will expand into development of equipment to assist in local food production and open source technology for the global community.

Robotics Systems Enterprise: From the time people wake up in the morning to the time they go to sleep at night, they are surrounded by electronics. However, none of these devices compare to the advanced systems used in the Robotics Systems Enterprise. Projects include a vision system that triangulates the location of a molten steel nozzle to an intelligent power management system.
that powers the Great Lakes Research weather buoys. At Design Expo, hosted by Pavlis Honors College and the College of Engineering, more than 600 students on Enterprise and Senior Design teams display their work and compete for awards each spring. Each Senior Design team displays a poster and many give formal presentations on their projects.

A panel of judges made up of corporate representatives and Michigan Tech staff and faculty members critique the projects. Team projects are sponsored by industry, giving students valuable experience through competition and direct exposure to real industrial problems.

**BonzAI Brawl**
The BonzAI Brawl is an all-day artificial intelligence programming competition where teams of one to three design autonomous agents capable of overcoming challenges and out-performing their opponents. Teams have eight hours to craft, tweak, and perfect their strategy before their AIs are entered into the Brawl. In the Brawl the AIs face off against one another in a tournament to determine which is the most capable.

**WiCS**
Women in Computing Sciences (WiCS) are a diverse group dedicated to supporting women in STEM fields. WiCS sees women in the computing sciences as a valuable resource and aim to aid their development and growth as professionals in their field. WiCS stands for fostering friendships, connections, and supportive environments that encourage the underrepresented population of women in the sciences to feel proud of their achievements and gain a sense of community. WiCS believes scientific women bring new perspectives, new ideas, and an entirely new way of thinking to their field that should be embraced and nurtured. WiCS hopes that by existing on campus, WiCS can empower more women to strive for excellence in scientific fields and help them along that journey.

**UPE**
Upsilon Pi Epsilon is the international honor society for the computing and information disciplines and strives for the promotion of high scholarship and original investigation in the fields of computer and information sciences. The membership is made up of individuals whose academic achievements, reputation, and creative abilities deserve recognition and enhance the stature of the association. UPE’s mission is to recognize academic excellence at both the undergraduate and graduate levels in the computing and information disciplines.

**ACM**
The Michigan Tech student chapter of the Association for Computing Machinery, or ACM@MichiganTech, promotes an increased knowledge of the science, design, development, construction, languages, management, and applications of modern computing machinery. It promotes communication and interaction between students interested in computing machinery, faculty and staff involved with computing machinery, and computing machinery itself.
Research Awards

Laura Brown
CRISP Type 2—Revolution through Evolution: A Controls Approach to Improve How Society Interacts with Electricity
National Science Foundation
Pl: Laura Brown; Co-Pl: Chee-Wooi Ten, Wayne Weaver
September 15, 2015–August 31, 2018
$699,796

Distributed Agent-based Management of Agile Microgrids
US Army
Pl: Gordon Parker; Co-Pl: Laura Brown, Wayne Weaver, Steven Goldsmith
July 2, 2013–July 1, 2017
$52,014

Adaptive Memory Resource Management in a Data Center—A Transfer Learning Approach
National Science Foundation
Pl: Laura Brown; Co-Pl: Zhenlin Wang
October 1, 2014–September 30, 2017
$299,993

Timothy Havens
Heterogeneous Multisensor Buried Target Detection Using Spatiotemporal Feature Learning
US Department of Defense
Pl: Timothy Havens; Co-Pl: Timothy Schultz
December 1, 2015–November 30, 2018
$983,124

Implementation of Unmanned Aerial Vehicles (UAVs) for Assessment of Transportation Infrastructure
Michigan Department of Transportation
Pl: Colin Brooks; Co-Pls: Timothy Havens, Richard Dobson, Theresa Ahlborn, Amlan Mukherjee, Kuilin Zhang, Thomas Oommen
March 1, 2016–February 28, 2019
$598,526

Multistatic GPR for Explosive Hazards Detection
Akela; US Army SBIR (A15-109)
Pl: Timothy Havens; Co-Pls: Joseph Burns, Adam Webb; (Akela Pl: Allan Hunt)
March 1, 2016–September 30, 2016
$33,468

Multisensor Analysis and Algorithm Development for Detection and Classification of Buried and Obscured Targets
ARO (W911NF-16)
Pl: Timothy Havens; Co-Pls: Joseph Burns, Timothy Schultz
April 1, 2016–March 31, 2019
$99,779

Advanced Signal Processing and Detection Algorithms for Handheld Explosive Hazard Detection
US Army (W909MY-13-C-0013)
Pl: Joseph Burns (MTRI); Co-Pls: Timothy Havens, Brian Thelen (MTRI), Mark Stuff (MTRI), Joel LeBlanc (MTRI), Adam Webb (MTRI); Student: Anthony Pinar (ECE)
September 1, 2013–September 30, 2016
$1,238,255

Scott Kuhl
University, Community College, and Industry Partnership: Revamping Robotics Education
to Meet 21st Century Workforce Needs
National Science Foundation
Pl: Aleksandr Sergeyev; Co-Pl: Abdul Nasser Alaraje, Scott Kuhl
June 1, 2015–May 31, 2018
$136,930

PLC Education Through Simulation and Games
Bay de Noc Community College
Pl: Scott Kuhl; Co-Pl: Abdul Nasser Alaraje
June 1, 2014–December 31, 2016
$158,192

Myounghoon Jeon
Interactive Robotic Orchestration: Music-Based Interactive Robotic Orchestration for Children with ASD
National Institutes of Health through the National Robotics Initiative
Pl: Myounghoon Jeon
June 1, 2014–May 31, 2017
$258,362

EQUOS-MTTI-Sonic Information Design
EQUOS Research Company, Tokyo, Japan
Pl: Myounghoon Jeon
May 1, 2015–March 30, 2016
$69,407

Jean Mayo
Accessible Access Control
National Science Foundation
Pl: Jean Mayo; Co-Pl: Chaoli Wang, Steven Carr, Ching-Kuang Shene
September 1, 2013–August 31, 2016
$199,164

Visualization and Analysis for C Code Security
National Science Foundation
Pl: Jean Mayo; Co-Pl: Ching-Kuang Shene
January 1, 2016–December 31, 2017
$130,001

Saeid Nooshabadi
Verification of NUADC Performance
Google
Pl: Daniel Fuhrmann; Co-Pl: Saeid Nooshabadi
$100,000

Soner Onder
Sphinx: Combining Data and Instruction-Level Parallelism through Demand-Driven Execution of Imperative Programs
National Science Foundation
Pl: Soner Onder
August 1, 2015–July 31, 2019
$560,000
REU Supplement: $15,876

Robert Pastel
Copper Country Historical Spatial Data Infrastructure
National Endowment for the Humanities
Pl: Donald Lafreniere; Co-Pls: Robert Pastel, Sarah Scarlett, John Arnold
May 1, 2016–April 30, 2019
$434,485

CI-TEAM Demo: Environmental Cyber Citizens: Engaging Citizen Scientists in Global Environmental Change through Crowdsensing and Visualization
<table>
<thead>
<tr>
<th><strong>External Funding and Awards</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>National Science Foundation</td>
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<tr>
<td>September 1, 2011–August 30, 2015</td>
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<tr>
<td>$249,890</td>
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<tr>
<td><strong>Ching-Kuang Shene</strong></td>
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<tr>
<td>Graph-Based Techniques for Visual Analytics</td>
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<td>National Science Foundation</td>
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<tr>
<td>PI: Ching-Kuang Shene</td>
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<tr>
<td>September 1, 2014–July 31, 2017</td>
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<tr>
<td>$67,216</td>
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<tr>
<td><strong>Min Song</strong></td>
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<tr>
<td>Under-Ice Mobile Networking: Exploratory Study of Network Cognition and Mobility Control</td>
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<td>National Science Foundation</td>
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<tr>
<td>PI: Min Song; Co-PI: Zhaohui Wang</td>
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<tr>
<td>September 1, 2015–August 31, 2017</td>
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<tr>
<td>$299,716</td>
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<tr>
<td>The Ontology of Inter-Vehicle Networking with Spatio-Temporal Correlation and Spectrum Cognition</td>
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<td>National Science Foundation</td>
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<tr>
<td>PI: Min Song</td>
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<tr>
<td>October 1, 2015–September 30, 2018</td>
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<tr>
<td>$221,797</td>
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<tr>
<td>Research Support for the Institute of Computing and Cybersystems</td>
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<td>House Family Foundation</td>
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<tr>
<td>PI: Min Song; Co-PI: Daniel Fuhrmann</td>
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<tr>
<td>July 1, 2015–June 30, 2017</td>
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<tr>
<td>$671,000</td>
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<tr>
<td><strong>Keith Vertanen</strong></td>
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<tr>
<td>Less is More: Investigating Abbreviated Text Input Via a Game</td>
</tr>
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<td>Google</td>
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<tr>
<td>PI: Keith Vertanen</td>
</tr>
<tr>
<td>August 29, 2016–August 28, 2017</td>
</tr>
<tr>
<td>$47,219</td>
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<tr>
<td><strong>Charles Wallace</strong></td>
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<tr>
<td>Agile Communicators: Preparing Students for Communication—Intensive Software Development through Inquiry, Critique, and Reflection</td>
</tr>
<tr>
<td>National Science Foundation</td>
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<tr>
<td>PI: Charles Wallace; Co-PI: Leo Ureel, Shreya Kumar</td>
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<tr>
<td>September 1, 2015–August 31, 2017</td>
</tr>
<tr>
<td>$219,201</td>
</tr>
<tr>
<td>REU Supplement: $21,700</td>
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<tr>
<td><strong>Zhenlin Wang</strong></td>
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<tr>
<td>Effective Sampling-Based Miss Ratio Curves: Theory and Practice</td>
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<tr>
<td>National Science Foundation</td>
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<tr>
<td>PI: Zhenlin Wang</td>
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<td>October 1, 2016–September 30, 2019</td>
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<td>$375,000</td>
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<tr>
<td><strong>Outreach and Development</strong></td>
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<tr>
<td><strong>Laura Brown</strong></td>
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<td>BonzAI</td>
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<tr>
<td>Jackson National Life Insurance</td>
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<tr>
<td>PI: Laura Brown; Co-PI: Nilufer Onder, Scott Kuhl</td>
</tr>
<tr>
<td>$2,000</td>
</tr>
</tbody>
</table>
#### External Funding and Awards

**Nilufer Onder**  
ACM Hackathon  
Target  
PI: Nilufer Onder  
$10,000

**Linda Ott**  
NCWIT Extension Services Min-Grant  
NCWIT  
PI: Linda Ott; Co-PI: Leonard Bohmann, Glen Archer, Leo Ureel, Christopher Cischke, Allison Carter  
$8,000

NCWIT Student Seed Funds  
Google  
PI: Linda Ott  
$3,000

Google CS4HS  
PI: Linda Ott; Co-PI: Leo Ureel, Charles Wallace  
$35,000

**Leo Ureel**  
Inspiring Young Coders in the Copper Country  
Google Ignite  
PI: Leo Ureel  
$5,400

NCWIT Aspirations  
NCWIT  
PI: Leo Ureel  
$1,500

Heart Behind the Oval  
Ford  
PI: Leo Ureel  
$1,000

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**Teaching Awards and Recognition**

Ali Ebnesasir was nominated for Michigan Tech’s 2016 Distinguished Teaching Award. As one of five finalists from among all teaching faculty, Ebnesasir is now a member of the Michigan Tech Academy of Teaching Excellence.

Keith Vertanen, Nilufer Onder, Myounghoon Jeon, and Scott Kuhl are four of 85 Michigan Tech instructors who received an exceptional student evaluation score in spring 2016. Their scores are in the top 10 percent of similarly sized sections.

David Poplawski is one of 91 instructors among all Michigan Tech teaching faculty who received an exceptional student evaluation score in fall 2015. Poplawski’s score is in the top 10 percent of similarly sized sections.
The Department of Computer Science External Advisory Board (EAB) is a group of corporate and government leaders. EAB members share their expertise and provide an independent review of our undergraduate programs and the current trends in industry. They offer professional insight and make recommendations for changes to programs and administration. EAB members also raise funds from private, foundation, and corporate sources.

David Behen
Director and Chief Information Officer
Department of Technology, Management & Budget
State of Michigan

William Frantz
Embedded Software Engineer
Ford Motor Company

John Furton
Family Online

Garret Gaw
Technology Leader
Amazon

Amy Johnson
Head of Customer Success
Clari

Dale Luck
Senior Software Engineer
Roku

Dianne Marsh
Director of Engineering Tools
Netflix

Jack Matheson
Software Architect
Intel Corporation

Jeff Melendy
Web and Mobile Development Leader
J. J. Keller and Associates

Patrick Moore
VP of Engineering
WhalePath

Donn Schneider
Technologist
Wisconsin Public Service Corp.

Robert Sweet
Director of Systems and Programming
Jackson National Life Insurance

Brian VanVoorst
Technical Director
BBN Technologies

Cynthia Watson
Manager of IT Operations, Strategy, and Planning
Ford Motor Company
First-year women made up 17 percent of our student body last year—a record high.

15 professors received external funding as Principal Investigator or co-Principal Investigator in 25 new research grants totaling $5 million.

New research funding increased by 235 percent.

16 tenured and tenure-track professors

16 computer science faculty members in the Institute of Computing and Cybersystems

20 journal articles, nine book chapters, and one book

68 conference papers

20 faculty members

450 undergraduates and 49 graduate students

MICHIGAN TECHNOLOGICAL UNIVERSITY 59