



## Turing Award Winner Returns to MSU for Honorary Degree

**C**harles Bachman (’48) was recognized by MSU’s College of Engineering with an honorary doctorate in December 2015 for his lifetime achievement and contributions to computer science—and database architecture in particular. Bachman has received many honors and awards in his career including an ACM Fellow, the Turing Award, and the Presidential Medal of Technology and Innovation from President Obama. Bachman’s career included stints at Dow Chemical, General Electric, Honeywell, Cullinet, and eventually his own computer assisted software engineering (CASE) company—Bachman Information Systems.

Bachman’s post-war career began at Michigan State followed by graduate work at UPenn. His first job at Dow Chemical took him through various departments from 1950–1960. This journey through Dow’s functional areas was driven by his engineer’s mind and unique vision for how data and systems could be better designed for business efficiencies.

In 1960, Bachman was recruited by General Electric to continue his path-breaking leadership in computer data systems. Bachman recalls that GE had a hundred autonomous business groups, each making different products. Each business unit preferred to have its own manufacturing control system. However GE had the foresight to see that computers, data, and software programs could support

a generic control system that would be far more effective. Bachman was to be the architect for this new system that yielded the first direct access database management system (DBMS), Integrated Data Store (IDS), as one of its by-products. The invention served as the foundation for the world’s first general purpose manufacturing resource planning (MRP) system, and a few years later the two were used to create the world’s first online transaction processing system (OLTP).

In 1978, the International Organization for Standardization (ISO) formed a technical committee to develop solutions for computers to talk to one another, exchange data, and thus allow programs to interoperate. Bachman was elected to

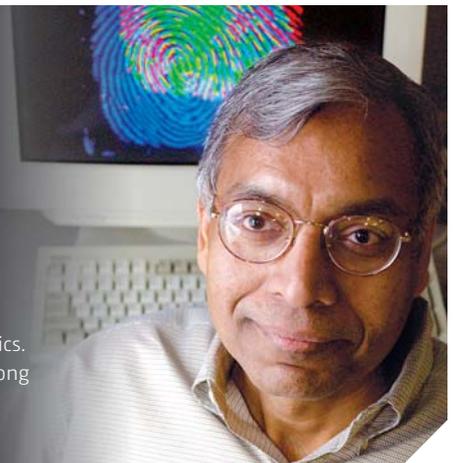
chair one of the more significant groups in this open systems interconnection (OSI) effort that led to the familiar seven-layer networking architecture known as the OSI Reference Model that is widely deployed in various implementations.

Bachman’s career continued to focus on database architecture innovations but moved from manufacturing corporations to software companies. Feeling the entrepreneurial bug, he formed his own company, Bachman Information Systems, which went public (NASDAQ: BACH) and was later acquired by Computer Associates. After that exit, he focused on writing and consulting assignments. He now lives in a retirement community in Lexington, Mass. ✿

> Rick Ducey

## Anil Jain Named NAE Member

Congratulations to University Distinguished Professor **Anil Jain**, elected a member in the National Academy of Engineering Class of 2016—for contributions to the engineering and practice of biometrics. The honor, announced Feb. 8, is among the highest professional distinctions accorded to an engineer. ✿



FROM THE CHAIR  
**Matt Mutka**



I am pleased to report that the National Science Foundation renewed its support of the MSU BEACON Science and Technology Center due to the significant successes of BEACON researchers in

its first five years. The center brings together researchers of many disciplines, including computer science, and continues to attract talented graduate students.

In other areas of impact, I wish to highlight the many efforts of Professor Laura Dillon to attract more women and underrepresented groups to computer science. MSU was rewarded with a Pacesetter grant from the National Center for Women & Information Technology (NCWIT) to increase recruitment and retention of women, first-generation students, and students of color in computer science. Many other examples of innovative activities are taking place within the department.

The number of computer science majors keeps increasing dramatically each year. In response, the department is recruiting several additional faculty members for the coming fall.

Meanwhile, we are pleased to welcome Jiayu Zhou and Hu

Ding, who recently joined the department as assistant professors. Both are experts in areas of data science, including large-scale data and machine learning. Furthermore, we are pleased to announce that Wolfgang Banzhaf will join the department this fall as the John R. Koza Endowed Chair in Genetic Programming. In addition, new teaching specialists recently joined our department. Sebnem Onsay comes to MSU after teaching for an extended time at Oakland University. Joshua Nahum joined the department after working as a postdoctoral researcher with BEACON.

A highlight each semester is the graduation of our students at the commencement ceremonies. This past semester, in addition to celebrating our students as they begin their careers after graduation, we were honored to host a distinguished MSU alumnus, Charles Bachman, who made historic contributions to computing. Among the many honors in his career, Mr. Bachman received the ACM Turing Award in 1973 for outstanding contributions to database technology. The Turing Award is the highest award granted in the field of computer science. It was our pleasure to welcome Mr. Bachman and his family to campus to honor him as one of MSU's distinguished alumni. 🌟



## Girls Learn Computing at MSU Summer Camp

Fun at camp. Around two dozen middle school girls attended the Girls in Computing Summer Camp at MSU in 2015 to learn basic programming concepts and participated in several hands-on activities. Girls were introduced to the logic of computer science using “CS Unplugged”—a project that provides free games and activities to communicate computer science concepts to students. The camp was organized by Teresa Isela VanderSloot, MSU's College of Engineering director of Women in Engineering, Recruitment and K–12 Outreach. 🌟



## MSU's BEACON Center Nets Grant to Continue Evolution Research

MSU has been awarded \$22.5 million by the National Science Foundation to continue the research, education, and outreach activities of the BEACON Center for the Study of Evolution in Action.

Since 2010, BEACON has brought together evolutionary biologists, computer scientists, and engineers to explore evolution going on in today's world. BEACON researchers have provided insights into the evolution of disease, reducing the evolution of antibiotic resistance and predicting how

populations of organisms respond to climate change.

The use of digital organisms—self-reproducing computer programs operating in a controlled computer environment—allows researchers to explore evolutionary dynamics much more rapidly than studies in the lab or field. Understanding these processes contributes to better solutions of design and engineering problems of industrial and societal importance using evolutionary computational tools, according to Erik Goodman, BEACON director.

“BEACON's world-class faculty members, all pulling toward common goals, enable our high level of scientific innovation, attracting top-notch graduate students and postdoctoral researchers to the best place in the world to study evolution in action,” he said.

Overall, BEACON researchers have published more than 565 peer-reviewed papers and written proposals that have netted nearly \$47 million in external funds. 🌟

# Women in Computing

## MSU a Pacesetter in Attracting More Women into Computer Science

MSU is one of three Michigan institutions selected for the National Center for Women & Information Technology (NCWIT) Pacesetters program, a project designed to attract more women into the field of computer science.

Pacesetters is a two-year program in which participating institutions develop aggressive and measurable goals for increasing the number of women in the U.S. computing and technology workforce. It is sponsored by the National Science Foundation, Google, and Qualcomm.

The number of females majoring in computer science at MSU has steadily increased from 7 percent in 2008 to the current 15 percent. On the strength of past programs supported by the center, MSU was awarded a 2015 NCWIT Extension Services Transformation Award.

In its Pacesetters program, MSU is partnering with Lansing Community College to increase recruitment and retention of women, first-generation students, and students of color in computer science, said Laura Dillon, professor of computer science and engineering at MSU.

The partnership will use courses at the community college to provide affordable introductory programming experiences for at-risk students enrolled at Michigan State. Pacesetters also will reach out to K-12 guidance counselors to help broaden the diversity of the computing workforce, Dillon said.

This year's grants went to 42 organizations nationwide, including MSU, Michigan Tech, and the University of Michigan. With three universities chosen and a community college partnership, Michigan is one of the three best-represented states in Pacesetters.

Michigan has more than 16,000 job openings in computing right now.

## Igniting Passion for CS in Young Minds

MSU Women in Computing joined with the Information Technology Empowerment Center (ITEC) and the Michigan Council of Women in Technology (MCWT) to help ignite a passion for computer science in young minds. Through IgniteCS, a Google initiative, they mentored students participating in 2020 Girls Clubs at four Lansing-area middle schools and high schools throughout the spring 2015 semester. IgniteCS supports student groups committed to developing and delivering outreach programs, aiming to



The number of females majoring in computer science at MSU has increased from 7 percent in 2008 to the current 15 percent. Professor Laura Dillon (*back, center*) is a leader in MSU's Women in Computing efforts and works with students including Keerthana Kolisetty (*left, standing*), and (*seated, left to right*) Sarah Byrum, Jessica Lam, Cassandra Thompson, and Shivaani Annadurai in a CSE291 class.

spark interest in computer science for K-12 students, especially underrepresented minorities and girls.

## Commitment Continues at Rwandan Technology Camp

Over the past three summers, Camp TechKobwa has touched the lives of more than 150 young Rwandan women and 30 teachers ("Kobwa" is the Kinyarwanda word for "girl").

The weeklong technology camp for Rwandan girls and secondary-school teachers, launched in 2013 by the Peace Corps, teaches technical and leadership skills. It provides access to computers, as well as a curriculum that helps develop skills and confidence in using information

and communications technology (ICT).

Laura Dillon, CSE professor, Louise Hemond-Wilson (BS '86), and Blair Singleton, ECE PhD student, played key roles in TechKobwa '14 and TechKobwa '15, and are helping organize two yearly TechKobwa Camps—one in August and the other in December.

"It is exciting to witness the transformation these young women undergo in just five days at TechKobwa," Dillon said.

Outcomes of TechKobwa '15 revealed that student confidence in technical ability increased significantly; 100 percent of teachers said that their ICT skills increased during camp; and 90 percent of teachers left camp with the knowledge and confidence to teach ICT in clubs and courses. 🌱



Camp TechKobwa aids young women in Rwanda in learning the fundamentals of robotics, logical reasoning, visualization skills, and working in teams.

## Meet Our New Faculty



Hu Ding

**Hu Ding** joined the department as an assistant professor in January 2016. He received his PhD from the Department of Computer Science and Engineering at the State University of New York at Buffalo. He received his bachelor's degree in mathematics from Sun Yat-Sen (Zhong Shan) University in 2009. His research centers on designing efficient geometric algorithms for large-scale and high-dimensional problems. His research emphasizes both theoretical developments and their applications in the real world. He has published a number of papers in top conferences and journals, including SODA, NIPS, AAAI, CVPR, and *PLoS Computational Biology*.



Joshua Nahum

**Joshua Nahum** officially joined the department as a teaching specialist in January 2016, but has co-instructed courses for CSE since 2014. He was a BEACON Distinguished Postdoctoral Fellow at MSU for the two years preceding his current appointment. He teaches a revamped CSE 480 (Database Systems). The class teaches effective use and construction of databases from the foundation up and heavily utilizes practical programming projects and homework. His interests include bringing such methodology to future classes.



Sebnem Onsay

**Sebnem Onsay** joined the department as a teaching specialist in January 2016. She comes to MSU from Oakland University's School of Engineering, where she served



Jiayu Zhou

## CSE Research Highlights

### Xiaoming Liu's Work Funded by GE, TechSmith

**Xiaoming Liu**, assistant professor of computer science and engineering, has received a two-year grant from GE. This project aims to develop an intelligent vehicle system to automatically detect the trailer tongue from the rear-view camera. The system should be robust to the diverse variation in trailer type, distance, viewing angles, and weather condition. Funding will begin this September.

He has also been collaborating on a research project with TechSmith since August 2013. The objective of this project is to develop a set of computer vision algorithms for analyzing sports videos captured by mobile phones. The researchers have been focusing on the problems of sports genre categorization, motion

saliency detection, and global motion compensation. The grant continues until August.

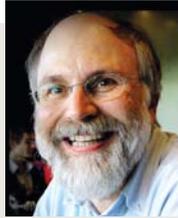
### Two Receive NIH R01 Grant

**Xiaoming Liu**, assistant professor of computer science and engineering, and **Arun Ross**, associate professor of computer science and engineering, have been awarded an NIH R01 grant entitled "Quantitative Molecular and Cellular MRI of Hepatocyte Transplantation." The project team includes Erik Shapiro (radiology) and James Luyendyk (veterinary medicine). For many severe liver diseases, the only effective treatment is liver transplantation. Hepatocyte transplantation (HTx) has been proposed and used as an alternative treatment, with limited long-term success

in humans. A major unsolved question in HTx is, how can we dynamically monitor and even quantify cell transplantation? The CSE team will develop machine learning, computer vision, and visualization schemes for automated data quantification.

### NSF Funding Supports Alex Liu's Research

**Alex Liu**, associate professor of computer science and engineering, has been awarded a three-year research grant from the Secure and Trustworthy Cyberspace program at NSF. The project is in collaboration with M. Zubair Shafiq, who graduated from MSU in 2014 under the supervision of Liu and is currently an assistant professor at the University of Iowa; and Zhiyun Qian, who is currently



## MSU Hires Nation's First Endowed Chair in Genetic Programming

**Wolfgang Banzhaf** will join the department as a professor in August 2016. He is currently head of the Department of Computer Science at Memorial University of Newfoundland in Canada.

He will become the first endowed chair in genetic programming in the United States. He will be the first to hold the John R. Koza Endowed Chair in Genetic Programming.

Genetic programming techniques evolve computer programs to solve problems, ranging from finding and fixing bugs in existing software to generating new programs that control robots or identify financial market trends. To further the field, Koza sponsors an annual evolutionary computation competition in which participants solve problems traditionally seen as requiring human intelligence to solve, such as generating new patentable designs, writing new computer programs or debugging human-written ones, or beating human competitors in games.

Banzhaf is one of the co-authors of *Genetic Programming: An Introduction*, a classic text in the field, as well as the sole author of *Linear Genetic Programming*, which provided a new basis to view genetic programming, extending the original work of Koza to new domains. 🌸

an assistant professor at the University of California at Riverside. The objective of this project is to understand and strengthen the security of Multipath TCP (MPTCP)—an IETF standardized suite of TCP extensions that allow one MPTCP connection, consisting of multiple sub-connections between two hosts, to use multiple paths simultaneously. The project is expected to raise awareness of MPTCP security and ultimately yield a foundation for MPTCP security. The study will further increase the acceptance of MPTCP as an efficient, trustworthy, and next-generation transport layer protocol, especially considering that the deployment of new protocols can always be hindered by security concerns. The results will lead to development of guidelines and specifications for MPTCP through standards organizations such as IETF.

### Liu Receives Research Gift from Google for Virtual Cellular Data Services

Alex Liu, associate professor of computer science and engineering, has received a research gift from Google to support his research on detecting and localizing performance degradation for virtual cellular data services. Mobile Virtual Network Operators (MVNOs) have become popular as they provide more flexible plans, often better services, and typically lower prices. For example, both Google

and Amazon have been planning to enter this space. To best serve customers and maintain competitiveness, MVNOs need to quickly detect and react to performance degradations experienced by end users; however, this is a challenging task as MVNOs do not have direct access to the underlying MNO networks. This research effort will yield frameworks and algorithms for MVNOs to quickly detect and localize end-to-end (E2E) service performance degradations.

Liu has also been named to the editorial board of the *IEEE Transactions on Dependable and Secure Computing (TDSC)*.



### Research Shows Fingerprint Accuracy Stays the Same over Time

Fingerprints have been used by law enforcement and forensics experts to successfully identify people for more than 100 years. Though fingerprints are assumed to be infallible personal identifiers, there has

been little scientific research to prove this claim to be true. As such, there have been repeated challenges to the admissibility of fingerprint evidence in courts of law.

“We wanted to answer the question that has plagued law enforcement and forensic science for decades: Is fingerprint pattern persistent over time?” said Anil Jain, University Distinguished Professor of computer science and engineering. “We have now determined, with multilevel statistical modeling, that fingerprint recognition accuracy remains stable over time.”

Jain, along with his former Ph.D. student Soweon Yoon, who is now with the National Institute of Standards and Technology, used fingerprint records of 15,597 subjects apprehended multiple times by the Michigan State Police over a time span varying from 5 to 12 years.

The results show that fingerprint recognition accuracy doesn’t change even as the time between two fingerprints being compared increases.

The paper by Yoon and Jain, published in the *Proceedings of the National Academy of Sciences*, is the largest and most thorough study of the persistence of Automated Fingerprint Identification Systems, or AFIS, accuracy.

Experts agree that Jain’s research addresses one of the most fundamental issues in fingerprint identification and is of great importance to law enforcement and forensic science. 🌱

## Awards & Honors

### Ofria Elected President of International Society for Artificial Life

Charles Ofria, professor of computer science and engineering, has been elected for a two-year term as president of the International Society for Artificial Life (ISAL). The organization is a democratic, international, professional society dedicated to promoting scientific research and education relating to artificial life, including sponsoring conferences, publishing scientific journals, and maintaining websites related to artificial life.

### Jain Honored for Innovation

Anil Jain, a University Distinguished Professor of computer science and engineering, was named a fellow of the National Academy of Inventors in December. He earned the honor for his contributions to patents and licensing, innovative discovery and technology, significant impact on society, and support

and enhancement of innovation.

Jain’s research focuses on pattern recognition, computer vision, and biometric recognition. Throughout his career, he has worked with several agencies—including the FBI and the Depart-

ment of Defense—helping to improve and advance security. As a result of his research and development, he has been assigned six U.S. patents on fingerprint matching, which have been transferred to IBM, and two Korean patents on surveillance. 🌱

### Artificial Intelligence and Evolution Takes Gaming to the Next Level

An assistant professor of integrative biology and computer science and engineering has developed an artificial intelligence system for video games that adapts to the player’s behavior by Darwinian evolution. *Game on!*

Arend Hintze said that unlike traditional artificial intelligence systems, which are typically limited to a set of instructions given to the computer-controlled opponents, this system gets smarter the more gamers play and the more data the system acquires.

> *MSUToday*





## Determination: Beating the Odds to Pursue a Dream

**Jordyn Castor** ('15) entered the world nearly four months early, weighing just over a pound. Lifesaving acts performed in a neonatal intensive care unit in Grand Rapids, Mich., that day caused Castor's retinas to detach—which left her completely blind and set in motion an unforeseen chain of events that would shape Castor's life.

"My interest in technology and computer science started when I was in the second grade and my family bought our very first computer," she said. The

computer opened a new world for Castor.

Five years after that first computer arrived, Castor wrote her first program—for the National Federation of The Blind Youth Slam, a conference that encourages blind youth to consider careers in science, technology, engineering, and math. This inspired Castor to stay the course and study computer science.

While attending MSU, the Center for Spartan Engineering and the student organization, Women in Computing, made sure Castor was prepared for her career pursuits. She was awarded a stipend to cover a trip to the Grace Hopper Celebration of Women in Computing, the world's largest gathering of women technologists. It was at the Grace Hopper event that Castor landed a highly competitive internship with a top Wall Street investment bank and security management firm in New York City.

"You know, I've never been to a city of this capacity before," said Castor during her New York internship in summer 2014. "My family was nervous, but I told them these opportunities come around only once in a blue moon."

The investment bank was interested in Castor not only for her qualifications as a computer programmer, but for her determination to make software more usable for individuals who are disabled.

"MSU's Resource Center for Persons with Disabilities (RCPD) has been extremely helpful in ensuring my success,"

she said. "They have done everything in their power to make sure I succeed, including brailleing my textbooks by hand." RCPD also provided a scholarship to Castor to help cover living expenses while she was in New York.

"What really empowered me at MSU has been the opportunity to see the impact I can have on someone else's life. By just being myself and sharing my passions, I am able to make a real difference that can potentially shape the lives of others," Castor said.

Castor spent summer 2015 working as an intern in accessibility design and quality at Apple in California.

For her MSU capstone course project in December, Castor, along with three other team members, developed an app called Intelligent Real-World Text Recognition.

For use on Windows 10 devices (PCs, tablets, and cell phones), the app uses the device's camera to take a picture, recognize what it is, and then perform a task—like reading it aloud.

"One of its cool uses," said Castor, "is it can read your receipt to you or help you with a menu in a restaurant. The app also offers long-term storage of data."

"Don't let fear stop you. Take every opportunity as it comes, and don't let anything hold you back from pursuing your dreams and your goals," she said.

Castor received her bachelor's degree in December 2015 and has returned to Apple in California to work on accessibility design and quality.

To read more about Castor and view her inspiring video, go to <http://givingto.msu.edu/stories/story.cfm?id=33>.

> Portions of this story are courtesy of MSU Empower Extraordinary



## Student Develops New WiFi Technology

Whether we see it or not, we all move through a cloud of WiFi radio signals virtually wherever we go.

**Kamran Ali**, a PhD student in computer science and engineering, wants to use it to control a computer without a keyboard.

Ali came to MSU after graduating with a bachelor's degree in electrical engineering and computer science from the University of Lums in Lahore, Pakistan, in 2013. He then began studies at MSU in the computer science lab of Professor Alex Liu.

"Wireless signals can be used to sense activities in the environment," he said. "Everybody uses WiFi, and these devices are everywhere now—offices, homes, everywhere. We decided to see if we could detect small activities, like keystrokes, using WiFi signals."

Ali sees a future in which we type on a piece of paper, or use our hands to scroll through an application, all without touching any actual computer components. Off-the-shelf devices pick up the way those motions disturb the WiFi signals that are already bouncing around the room, and are translated into the appropriate action.

"We use only commodity WiFi devices," Ali said. "Today's WiFi devices, to keep up high throughput, continuously adapt to a changing environment. Those parameters, if we extract them and then apply signal processing and machine learning tools, can be used to detect activities." Like whether your first or second finger



is moving on a virtual keyboard. Or whether someone has fallen in a bathroom or hospital room.

Ali has used the techniques on both the 2.4 gigahertz and 5 gigahertz WiFi band. And yes, the folks at MSU's intellectual property arm, MSU Technologies, are on the chase for a patent on this technology.

He demonstrated the technology at MobiCom, an industry conference in Paris in September. 🌱

> Matt Roush, *TechCentury*

## Student Honors & Awards

### PhD Student Designated NIJ Graduate Research Fellow



CSE PhD student **Thomas Swearingen** has been designated a National Institute of Justice (NIJ) Graduate Research Fellow based on his proposal "Incorporating Graph-Based Models in a Deep Learning Framework for Operational Face Recognition." Swearingen will receive a stipend from NIJ toward completing his PhD program.

The biometrics specialist is from Ooltewah, Tenn. His undergraduate degree is from the University of Tennessee, Knoxville.

At MSU, his academic advisor is Arun Ross, associate professor of computer science and engineering.

### CSE Student Honored by Board of Trustees



**Angela Sun** was among seven students to receive an MSU Board of Trustees' Award for fall semester. The students were honored Dec. 18 at

the board's meeting for having the highest scholastic average at the close of their last semester at MSU; they each had a 4.0 GPA. Sun, who received her computer science degree, was also a member of MSU's Honors College.

### MasterCard Foundation Scholars

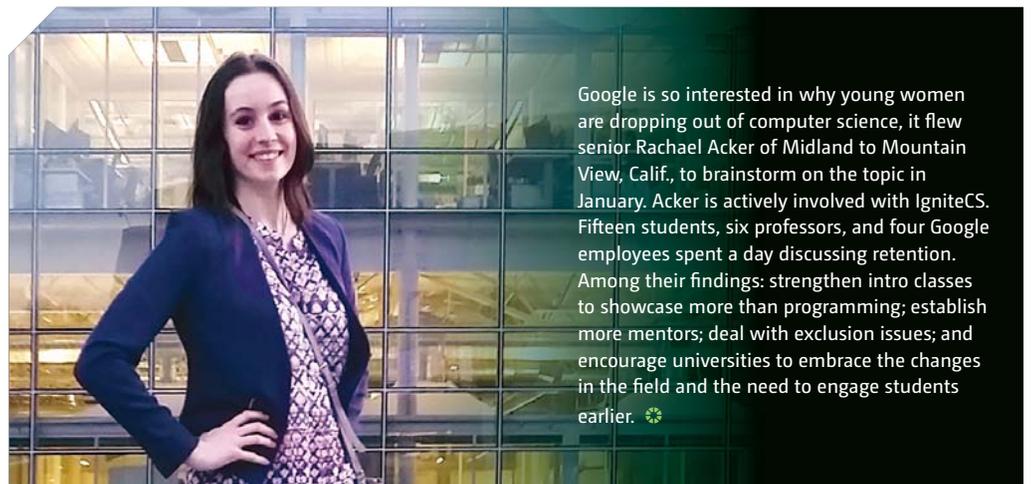
**Duale Mahat** from Kenya is a 2015 MasterCard Foundation Scholar majoring in computer science.

MSU partnered with The MasterCard Foundation in 2012 on a \$500 million education initiative. The MasterCard

Foundation Scholars Program provides talented, yet financially disadvantaged youth—especially those from Africa—with access to high-quality education.

Mahat joins two other MasterCard Scholars majoring in computer science—**Amanuel Goshu** from Ethiopia, and **Arnold Mutayoba** from Tanzania.

MSU is receiving \$45 million in funding from the foundation to support 185 scholars throughout the nine-year program, which includes 100 four-year undergraduates and 85 master's degree students. MSU will host the most scholars among the six U.S. partner institutions. 🌱



Google is so interested in why young women are dropping out of computer science, it flew senior Rachael Acker of Midland to Mountain View, Calif., to brainstorm on the topic in January. Acker is actively involved with IgniteCS. Fifteen students, six professors, and four Google employees spent a day discussing retention. Among their findings: strengthen intro classes to showcase more than programming; establish more mentors; deal with exclusion issues; and encourage universities to embrace the changes in the field and the need to engage students earlier. 🌱

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## A First! MSU Engineering Tops 1,000 Female Students



College of Engineering Dean Leo Kempel knows that these are exciting times at the college. There are about 5,200 undergraduates, including 1,000 women (freshmen to seniors) for the first time in college history.

"This fall we welcomed one of the largest classes of freshmen in more than 25 years, with women students making up 20 percent of the incoming class," Kempel said. "The college is well on its way to becoming one of the fastest rising engineering programs in the nation," he added. ♻️

**ABOVE:** The College of Engineering hit an enrollment milestone this fall with more than 1,000 women (freshmen to seniors)—about 20 percent of the college's student population. Among them are (left) computer science freshman Kristin Calder of Saline, Mich., and Sonja Berger, a junior from Fraser, Mich., majoring in electrical engineering. They were among the Spartan Engineers who gathered in September to celebrate the Women in Engineering milestone with some light-hearted fun to kick off the academic year.