School of Computing, Informatics, and Decision Systems Engineering

Intelligence unleashed
Computing for a “smart” world

2017 Report
Arizona State University
The Ira A. Fulton Schools of Engineering at Arizona State University offers 25 undergraduate programs and 41 graduate programs in its six schools:

- School of Biological and Health Systems Engineering
- School of Computing, Informatics, and Decision Systems Engineering
- School of Electrical, Computer and Energy Engineering
- School for Engineering of Matter, Transport and Energy
- School of Sustainable Engineering and the Built Environment
- The Polytechnic School

In the U.S., one in 72 graduating undergraduate engineers is a Sun Devil.

**Research expenditures**

$104M

Research expenditures FY2016-2017

**NSF CAREER awardees**

19

#3

Licenses and Options

Behind only Purdue and Carnegie Mellon

#4

IP Disclosures

Behind only Carnegie Mellon, Caltech and Purdue

#4

Startups

Behind only Purdue, Carnegie Mellon and Stanford

Comparative data per $10 million in research expenditures, based on the Association of University Technology Managers annual report of top national engineering schools.

Lead institution on two and partner on two National Science Foundation Engineering Research Centers

- QESST
- CBBG
- Freedom Systems Center

Lead institution on the Department of Homeland Security Center of Excellence

- CAOE

#1 in the U.S. for innovation

ASU ahead of Stanford and MIT

The School of Computing, Informatics, and Decision Systems Engineering has seen a tremendous year. As we move forward, my aim is strengthening our academic and research enterprise by building on the school’s legacy of excellence and innovation. Our achievements over the last year were not possible without the hard work and commitment of our faculty — a cadre of computer science and information experts — who are steadfast in their commitment to making transformative advances in human-technology systems.

In 2017, the school’s junior faculty impressed on the national level by receiving four National Science Foundation CAREER Awards. The NSF-funded research projects of Adam Doupé, Hanghang Tong, Fengbo Ren and Carole-Jean Wu sought to find unknown vulnerabilities in web applications, improve a network’s ability to function during a disturbance, fill unmet energy-efficiency needs with a data-driven internet of things framework and advance handheld device design from the user satisfaction perspective.

Our faculty also made strides in defense, health care and programmable matter with computing. Professor Gail-Joon Ahn became director the ASU Global Security Initiative Center for Cybersecurity and Digital Forensics, which develops tools and technologies to address challenges in cybersecurity. Assistant research professor Troy McDaniel created adaptive assistive computing technology to aid individuals with disabilities, such as people who are blind or have suffered strokes. Professor Andrea Richa helped develop a nature-inspired “amoebot” to explore programmable materials — a smart network of self-organizing particles that can monitor and respond to their environment. These represent just a few examples of the imaginative work that keeps our school at the forefront of information science.

We’ve hired seven new faculty to strengthen our key research areas and sustain the quality of education our students have come to know and appreciate. This initiative contributed to our school’s rise in U.S. rankings among computer science graduate programs.

Entering the 2018-2019 academic year, U.S. News & World Report ranked computer engineering as 29th, computer science as 43rd and industrial engineering as 17th in the nation.

The combination of our award-winning faculty, interdisciplinary research and nationally recognized undergraduate and graduate programs has attracted top students from across the country. Enrollment in our academic programs has seen substantial growth with 6,215 students enrolling in fall 2017.

We’re also a leader in online education. Our school boasts the first four-year online engineering management program for undergraduates. We also recently launched an online master’s program in computer science, enabling thousands of students around the world access to this rigorous curriculum.

I’m proud of the work we’re doing to extend our reach to underrepresented communities through initiatives like Building, Recruiting, And Inclusion for Diversity, or BRAID — a national partnership of 15 universities across the U.S. helping increase the percentage of women and underrepresented minorities in undergraduate computing programs and subsequently increasing diversity in the computing talent pipeline.

I look forward to continuing the partnership between our faculty, students and staff to pave the way for future innovations in human-aware robotics, big data systems, intelligent manufacturing systems, cyber defense strategies, smart infrastructure and so much more.

I’m energized about the future direction of the School of Computing, Informatics, and Decision Systems Engineering and hope you’ll join me as we continue to push it to the next level.

Sandeep Gupta
Director and Professor
School of Computing, Informatics, and Decision Systems Engineering

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A new era for computing sciences at Arizona State University

Director’s letter

$17M
2016-2017 research expenditures
$17,212,162

$23M
2016-2017 research awards
$23,254,003

$219M
2016-2017 research proposals
$219,938,251

Solving complex challenges, the DHS-funded Center for Accelerating Operational Efficiency improves emergency response and predictive tools for homeland security.

Answering the need for increased federal cybersecurity, the Center for Cybersecurity and Digital Forensics emphasizes cutting-edge research while creating a dependable workforce through scholarships and job placement.

7 NSF CAREER awards, 6 startups and 22 patents in the past three years
Fall 2017 enrollment
By degree program

<table>
<thead>
<tr>
<th>Program</th>
<th>Bachelor's</th>
<th>Master's</th>
<th>Doctoral</th>
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<tr>
<td>Computer engineering (computer systems)</td>
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<td>129</td>
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<tr>
<td>Computer science</td>
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<td>191</td>
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<td>Engineering management</td>
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<td>Informatics</td>
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<tr>
<td>Software engineering</td>
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-- No degree offered.

Total enrollment

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<tr>
<td>2016</td>
<td>5,672</td>
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<td>6,213</td>
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On-ground

<table>
<thead>
<tr>
<th>Year</th>
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<td>2013</td>
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<td>2016</td>
<td>4,666</td>
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Online

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<td>2013</td>
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<tr>
<td>2016</td>
<td>1,006</td>
</tr>
<tr>
<td>2017</td>
<td>1,227</td>
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Degrees granted 2016-2017
By degree program

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<th>Program</th>
<th>Bachelor's</th>
<th>Master's</th>
<th>Doctoral</th>
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<tr>
<td>Computer engineering (computer systems)*</td>
<td>71</td>
<td>63</td>
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<tr>
<td>Computer science</td>
<td>311</td>
<td>266</td>
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<tr>
<td>Engineering management*</td>
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<tr>
<td>Industrial engineering</td>
<td>82</td>
<td>69</td>
<td>5</td>
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<tr>
<td>Informatics*</td>
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<tr>
<td>Software engineering</td>
<td>95</td>
<td>99</td>
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*Program established in FY2012
-- No degree offered.

Total degrees granted

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On-ground

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<td>2016</td>
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Online

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<td>2016</td>
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<td>2017</td>
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Research

Expenditures

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<th>Amount</th>
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<td>FY2014</td>
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<tr>
<td>FY2015</td>
<td>$15,155,092</td>
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<td>FY2016</td>
<td>$15,732,422</td>
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<tr>
<td>FY2017</td>
<td>$17,212,162</td>
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Awards

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<th>Amount</th>
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<td>FY2017</td>
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</table>

Proposals (number)

<table>
<thead>
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<th>Year</th>
<th>Number</th>
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<tbody>
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<td>FY2013</td>
<td>(227)</td>
</tr>
<tr>
<td>FY2014</td>
<td>(268)</td>
</tr>
<tr>
<td>FY2015</td>
<td>(295)</td>
</tr>
<tr>
<td>FY2016</td>
<td>(320)</td>
</tr>
<tr>
<td>FY2017</td>
<td>(320)</td>
</tr>
</tbody>
</table>
Support
Donations support senior projects, student and faculty research, and improving the educational tools and opportunities we offer our students.

To make a donation of any amount, please call Lauren Bird at 480-727-7538, or mail your gift to:
Ira A. Fulton Schools of Engineering
Attn: Lauren Bird, P.O. Box 879309
Tempe, AZ 85287-9309

Please make checks payable to the “ASU Foundation” with “CIDSE” noted in the memo line.

Stay in touch
Keep up to date on news about Fulton Engineering and CIDSE at our news site, Full Circle
fullcircle.asu.edu

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(ASU School of Computing, Informatics, and Decision Systems Engineering) to connect with CIDSE students, alumni and faculty.

facebook.com/ASU.CIDSE

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Leslie Minton
Stephanie Mabee
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Rose Serago
Amanda Stoneman
Lanelle Strawder
Marshall Terrill
Kelsey Wharton
Erik Wirtanen
Pete Zrioka

Stock images provided by shutterstock.com
In January 2018, Sandeep Gupta was appointed director of Arizona State University’s School of Computing, Informatics, and Decision Systems Engineering — one of the six schools in the Ira A. Fulton Schools of Engineering.
Last spring when Sandeep Gupta was named the director of the School of Computing, Informatics, and Decision Systems Engineering, he was charged with leading the school in its quest to develop and promote world-changing ideas and technologies. Gupta welcomes the challenge.

“Dr. Gupta brings a wealth of knowledge and leadership experience to this role as director,” says Kyle Squires, dean of the Fulton Schools of Engineering. “We’re excited to work with Sandeep to increase the school’s impact and advance on the many opportunities where CIDSE is so well positioned for success. Its students, faculty, academic programs and research enterprise are absolutely essential to the Fulton Schools.”

Gupta joined the university in 2001 as a tenured associate professor, soon progressing to full professor. He earned a reputation as a respected teacher and accomplished researcher. Gupta has also excelled in administrative capacities. In 2016, he was named interim director for the school.

During that time, Gupta played an instrumental role in establishing multidisciplinary centers to enhance the school’s research through government and industry partnerships. He provided institutional support for the development of the Department of Homeland Security’s Center for Accelerating Operational Efficiency. And he secured vital resources and helped develop the framework for the Center for Assured and Scalable Data Engineering to take on large projects and initiatives that directly impact the energy, health, security and finance industries.

Under Gupta’s leadership, the school has sustained high-quality education in the face of its tremendous growth and has also attracted some of the nation’s brightest faculty members — both factors contributing to the school’s rise in the U.S. rankings among computer science programs.

Gupta is excited to make his mark on the school’s upward trajectory.

“It is truly an honor to be selected as the director of the School Computing, Informatics and Decision Systems Engineering,” says Gupta. “It’s an incredible opportunity to not only work with such an inspiring group of faculty and students but to continue to build relationships with communities and entities beyond academia that spur innovation and growth worldwide. I am thoroughly optimistic about the future of CIDSE.”

Gupta’s promise at guiding the school into the future is largely informed by his long history of research excellence and collaboration. He has spent his career conducting high-quality, interdisciplinary, use-inspired research with the potential for lasting change. With a focus on artificial intelligence, human-robot interaction, cybersecurity, IoT, smart transportation, autonomous vehicles and pervasive health care monitoring, Gupta’s vast research profile uniquely qualifies him to lead a school with such an extensive range of specialties.

Recurring themes throughout Gupta’s research have been sustainability and energy savings. His work on a two-tier thermal-aware computing and cooling management architecture to maximize renewable energy received a U.S. patent.

In the health care field, his contributions have included combining advanced sensors with wireless communication to monitor vital body functions and co-authoring a book introducing theoretical and practical techniques for biomedical sensor networking. Gupta is also the founding editor of the journal Smart Health, which focuses on devices, sensing, computing and communication technologies, software/hardware modeling and system architectures for pervasive health care. A pioneer in mobile computing, Gupta also co-authored the first mobile computing textbook.

As he settles into the role of school director, Gupta is working to reduce class size, hire additional lecturers, boost admission standards and match student aptitude with the school’s programmatic goals — all in an effort to contribute to ASU’s tradition of academic excellence and quality.

Each day, Gupta is charging ahead to fulfill his vision to lead the Fulton Schools of Engineering’s largest and fastest growing school to become one of the foremost proving grounds for innovation, entrepreneurship and collaboration in computing, informatics, industrial engineering, artificial intelligence, robotics and so much more.
Nowadays, when people want to buy something over the internet, they will type in their credit card information, name and address without giving it a second thought. In fact, a single vulnerability in a web application can allow an attacker to steal that personal information.

When Adam Doupé worked as a penetration tester for web applications, he realized he was building a mental model of how the web application worked and then trying to understand how the code was written in order to find vulnerabilities.

Doupé wondered if an automated tool could do the same thing. And that idea has earned the assistant professor an NSF CAREER Award to address the growing need for secure data solutions.

His research will focus on using inductive programming, a branch of machine learning, to interact with a web application and reverse engineer the source code and then identify vulnerabilities before an attacker can exploit them.
Consumers are always looking for better performance and better battery life in smartphones and likely won’t take one without the other. But for billions of smartphone users, performance is the biggest contributor of user satisfaction. And the phones can’t get too hot.

Carole-Jean Wu is harnessing both user satisfaction and low heat tolerance as a jumping off point for an NSF CAREER Award to better optimize mobile computing performance.

Wu, an assistant professor, is exploring solutions previously thought unusable by measuring performance quality through the lens of perceived application execution time. Another consideration is the particular “bursty” usage pattern common only to smartphones.

She and her team are taking a holistic approach to finding new methods to concurrently manage computation power, temperature profiles and runtime behavior for a better overall mobile experience as well as shed light on the design for a wide range of computing devices.

Carole-Jean Wu

NSF CAREER Award winner
People’s daily lives depend on various networks — from the electric grid and transportation systems to online social connections — running reliably.

At their most basic level, networks are a collection of nodes and links between those nodes. Using road systems as an example, a node would be an intersection and a link would be the roads connecting those intersections. Simple enough in a small town, but from the national perspective, this network is complicated with many opportunities for disruption.

With support from an NSF CAREER Award, Hanghang Tong seeks to create effective strategies and algorithms to ensure network robustness. Designing a unified suite of algorithms also means ensuring they’re scalable, adaptable and optimized for a wide variety of networks and robustification challenges.

The assistant professor will verify the algorithm suite works with real-world applications in an intelligent transportation system and an online social collaboration.
The internet of things could very well be the next big and transformative shift in technology, forever changing how people interact with the world.

Though the thought of connecting everything represents exciting new possibilities, there are significant challenges to deploying such devices at scale — too much data to handle and not enough power to transmit it.

Armed with an NSF CAREER Award, assistant professor Fengbo Ren seeks to create a practical and effective solution using data-driven compressive sensing.

This new model’s key idea is to use the sensor data to autonomously characterize signal models and capture individual variability. That knowledge informs compressive sensing, information decoding and even decision-making. The data-driven nature of the work makes the framework universal for all internet of things signals.

Ren is working with actual application scenarios and hardware constraints in mind to bring this solution into real-world applications.
Ross Maciejewski

Associate professor Ross Maciejewski combines his curious mind and computer skills to create a new way of seeing the world through geographical visualization and visual analytics.

As principal investigator, Maciejewski leads a five-year, $3 million award project as part of the NSF Innovations at the Nexus of Food, Energy and Water Systems program. The team of researchers are building decision support tools that look at the interdependence of these systems and helping develop sustainable policies for the future.

Maciejewski is also working with ASU’s Foresight Initiative, which received $20 million from the National Geospatial-Intelligence Agency to anticipate and mitigate national security risks associated with climate change, such as shortages of water, food and energy, and how they could contribute to political unrest.
An expert in computer vision and machine learning, Professor Baoxin Li puts people at the core of his research. He focuses on human-centered computing to improve lives profoundly.

As part of a project funded by the Minerva Research Initiative to address areas of importance to national security, Li will help study information cascades as they relate to the social-media posts of terrorist networks.

After working with a coworker who is blind, Li created tactile photographs. These computer-generated, two-dimensional images enable people with visual impairments to identify individuals by their facial contours. Now, he’s considering other applications to make it easier for people with visual impairments to navigate places such as shopping centers.

Li also serves as a mentor for the NSF Integrative Graduate Education and Research Traineeship program to help train the next generation of experts devoted to helping people with disabilities.
Our faculty build upon our school’s legacy of excellence and innovation

This past year, we hired seven new faculty to add capacity and expertise in the areas of artificial intelligence and cybersecurity. These dynamic new faculty are joining a cadre of computer science and information experts who are contributing to discoveries of foundational value. The school’s new faculty has a strong record of winning multiple prestigious early career awards, including seven NSF CAREER Awards in the last three years (2016-2018). We’re confident our new faculty will continue this tradition by driving innovations in human technology systems while strengthening our key research areas and sustaining our quality of education.

Ajay Bansal
Assistant Professor
PhD, The University of Texas at Dallas
Logic programming; constraint programming; answer set programming; data mining; machine learning; semantic computing; service-oriented architecture.

Stephanie Forrest
Professor and Director of the Biodesign Center for Biocomputation, Security and Society
PhD, University of Michigan
Biology of computation and computation in biology, including biological modeling of immunological processes and evolutionary diseases, cybersecurity, software engineering, evolutionary computation.

Stephanie Gil
Assistant Professor
PhD, University of California, Santa Barbara
Advancing the field of binary analysis with a focus on embedded firmware; web security; privacy; computer security education.

Yan Shoshitaishvili
Assistant Professor
PhD, University of California, Santa Barbara
Advancing the field of binary analysis with a focus on embedded firmware; web security; privacy; computer security education.

Siddharth Srivastava
Assistant Professor
PhD, University of Massachusetts at Amherst
Sequential decision making under uncertainty, integrated task and motion planning for robots, mobile manipulation, generalized planning, knowledge representation, probabilistic programming, probabilistic inference and machine learning.

Hao Yan
Assistant Professor
PhD, Georgia Institute of Technology
Real-time modeling and analysis with large-scale, high-dimensional data; data fusion for modeling of complex systems; smart adaptive sampling strategy and data reconstruction.

Tyler Baron
Lecturer
Computer science

Robert Reimar Heinrichs
Lecturer
Software engineering

Joseph Juarez
Lecturer
Industrial engineering
Awards and recognition

Ron Askin
IISE Albert G. Holzman Distinguished Educator Award

Ross Maciejewski
NSF INFEWS Award; Fulton Exemplar Faculty

Dan McCarville
A. Alan B. Pritsker Outstanding Industrial Engineering Teacher Award

Phill Miller
Top 5% Teaching Award

Shayok Chakraborty
2017 IEEE MultiMedia Best Department Article Award

Nadya Bliss
Member of Computing Community Consortium Council

Linda Chattin
Top 5% Teaching Award

Pitu Mirchandani
IEEE Fellow

James Collofello
Top 5% Teaching Award

Sethuraman Panchanathan
IEEE Phoenix Section Outstanding Leadership and Professional Service Award; 2017 IEEE MultiMedia Best Department Article Award; 2017 Alumnus of the Year Award, University of Ottawa; 2017 Distinguished Alumnus Award, Indian Institute of Technology, Madras, India; 2016 Best Demo Award, 24th ACM International Conference on Multimedia

Hanghang Tong
NSF CAREER Award

Adam Doupé
Engineering Teaching Excellence Award; NSF CAREER Award

Baoxin Li
Fulton Exemplar Faculty

Ethnomusicology Institute

Jing Li
2017 Mayo Clinic and ASU Alliance for Health Care Summer Residency Program

Fengbo Ren
Top 5% Teaching Award; NSF CAREER Award

Guoliang Xue
Top 5% Teaching Award

Andrea Richa
2017 Best Senior Researcher

Carole-Jean Wu
IEEE NSF CAREER Award; Young Engineer of the Year

Teresa Wu
2017 Best Senior Researcher

Jing Li
2017 Mayo Clinic and ASU Alliance for Health Care Summer Residency Program

Awards from the NSF
- Faculty Early Career Development Award — NSF INFEWS Award

Awarding professional associations, networks and societies
- Association for Computing Machinery — ACM
- Institute of Electrical and Electronics Engineers — IEEE
- Institute of Industrial and Systems Engineers — IISE
- Kern Entrepreneurial Engineering Network — KEEN

Subbarao Kambhampati
President, Association for the Advancement of Artificial Intelligence

Dan Shunk
Top 5% Teaching Award
Chokepoints and censorship: Protecting the free flow of information on the internet

The internet is a network of networks, and each network has a physical location through which traffic travels on physical lines to get to its destination.

Any network node that internet traffic passes through when it enters or exits a country’s internal networks is called a chokepoint.

The number of potential network chokepoints in a country reflects how easily a government could tamper with internet traffic either for cybersecurity or for repressing the freedom of communication for a country’s citizens.

Stephanie Forrest, computer science doctoral student Kirtus Leyba and her ASU research team are working with University of New Mexico Professor Jedidiah R. Crandall and University of California, Riverside Professor Michalis Faloutsos to develop tools and models to determine the topography of the global internet and countries’ chokepoint potential.

In a $1.4 million National Science Foundation-funded project led by Crandall to measure internet chokepoints, Forrest is helping policymakers, cybersecurity researchers and free speech advocates address issues related to internet freedom and security by providing accurate data and analyses of chokepoints.

We lack a worldwide view of how the internet’s network structure is changing over time, especially in ways that enable censorship and surveillance.

For certain network nodes, data known as routing tables are publicly available, showing how certain nodes talk to certain other nodes. With enough such data and by using simulation methods, researchers can infer a wider structure of how internet traffic is routed. But there are gaps in our understanding.

Crandall, the NSF project’s principal investigator, is developing side channel methods for inferring which IP addresses can talk to certain other IP addresses when data about the nodes is not publicly available.

“No one else has collected data at this scale,” Forrest says. “China isn’t necessarily going to let us install programs to measure traffic and connectivity, so how do you measure what’s going on inside of China [and other places] where information is being censored? It’s a technical trick to figure out a good method that will let you understand what’s going on inside the country from the outside.”

Once Forrest’s team has data to fill in a more complete map of network nodes, they need the tools to map out international network structures and potential chokepoints.

“There’s an additional step of simulating where internet traffic will actually go [through the possible paths of network nodes], and we’ve created a large (1 terabyte) data set to enable this simulation. We use this dataset to quantify the chokepoint potential of any country,” says Forrest, who is also director of the ASU Biodesign Center for Biocomputing, Security and Society.

Forrest’s role in the project is to model and simulate the data to determine trends and to present data in ways that make it useful for non-computer scientists. She has studied the past decade’s shifting potential for chokepoints among countries with more and less “free” internet network architectures to those that are more restrictive, ranging from the United States, France, Germany and the United Kingdom to China, Turkey, Egypt and Russia.

Seeing the chokepoint potential trends over time can provide clues for how countries may be implementing censorship, or how information is being intercepted and where.

These models can potentially help policymakers make better decisions and help them understand trends in particular countries. When she spent a year working on cyberpolicy at the U.S. Department of State, Forrest says that studies like these would have been invaluable in preparing for international negotiations related to cyberpolicy.

Forrest’s team will make their data sets and analysis tools publicly available for anyone to use.
New faculty

Stephanie Forrest, a computer science professor who holds a joint appointment with the ASU Biodesign Institute, studies the potential of censorship and surveillance as internet traffic crosses national borders. Photographer: Erika Groniek/ASU
Person first, software second

When software updates, usually you have to adapt to it.

But a team of researchers at ASU are creating adaptive assistive computing technology that makes the software adjust to you.

Assistant research professor Troy McDaniel is part of a research team focused on applying the new model to social assistive aids for individuals who are blind and rehabilitative technologies for individuals who have suffered strokes.

"It's a paradigm that proposes ideal technological designs as individualized designs: technology that adapts to its users over time through continual use," McDaniel says, adding that no two individuals or disabilities are the same, so individualized designs are necessary.

One application of the new paradigm is the Social Interaction Assistant, an assistive device that allows individuals who are blind access to nonverbal social cues, such as facial expressions. A body-worn or tabletop webcam would use machine learning and computer vision algorithms to recognize nonverbal cues and haptic, touch-based delivery devices for discreet, personal communication of those cues.

Led by executive vice president of ASU Knowledge Enterprise Development Sethuraman Panchanathan, McDaniel, Assistant Professor Shayok Chakraborty of Florida State University (formerly an assistant research professor at ASU), and postdoctoral research associate Ramin Tadayon, this work was published in an award-winning article titled, “Person-centered multimedia computing: a new paradigm inspired by assistive and rehabilitative applications.”

The paper, awarded the 2017 IEEE MultiMedia Best Department Article Award, introduced two applications within a new paradigm developed by Panchanathan, the director of the Center for Cognitive Ubiquitous Computing, called “person-centered multimedia computing.”

Software scrapes big data for big danger

Hasan Davulcu and Carolyn Forbes, assistant director of the Center for the Study of Religion and Conflict, have teamed up to find radical messages — both violent and positive — in an effort to counter violent extremism.

Initiated as a Department of Defense project, Looking Glass is the product of computer scientists, historians, anthropologists, Islamic studies scholars, sociologists and political scientists. It earned its name because it provides a visual lens into a group’s thinking. Currently, ASU is partnering with a private international development company called Chemonics to test the tool in Libya. Looking Glass identifies pro-social groups and positive social messages aimed at achieving Libyan unity, prosperity, security, cohesion and justice in order to support them and their goals of positive social change.

Solving the unsolvable problem

Nadya Bliss, the director of ASU Global Security Initiative and professor of practice in the Fulton Schools, talks applying innovation to the world’s toughest security challenges in an ASU KEDtalk.

Watch the video: scan the QR code or visit links.asu.edu/globalsecurityinitiative
ASU is one of only a few universities selected by the Department of Homeland Security to develop advanced tools for the nation’s security organizations.

DHS turned to CIDSE faculty for help improving operations in agencies including the TSA, U.S. Coast Guard, Federal Emergency Management Agency and Customs and Border Protection.

“That DHS chose ASU for this Center of Excellence speaks to ASU’s commitment to impactful, use-inspired research,” says Ross Maciejewski, who will serve as the center’s director. “We will develop new research and translate existing research into useful tools, such as data analytics, economic analysis or operations management systems that DHS organizations can put in place for improved decision-making and effectiveness.”

Some of the questions the center will explore include how to make TSA pre-screening more effective and how to develop tools to assess, mitigate and plan for threats, said Pitu Mirchandani, who will serve as the center’s chief scientist.

The new DHS Center of Excellence will be housed jointly in ASU’s Ira A. Fulton Schools of Engineering and Global Security Initiative. The new center brings $20 million in research funding to ASU in the first five years of the grant, with the potential to extend for another five years.

ASU’s strength in security research comes, in part, from the interdisciplinary nature of research teams involved in security-focused projects across campus.

The DHS center also will provide opportunities for students interested in careers focused on homeland security to conduct research and complete internships, giving ASU an opportunity to broaden its work in preparing the next generation of security practitioners.

“Allstate’s partnership with the CDF will help identify and understand potential risks to help the insurance company continue to provide excellent service and fulfill its business goals,” Ahn says.

Ahn’s center also partnered with Samsung Electronics.

“Through partnerships, the center aims to form relationships with industry, university and government entities that will play a critical role in producing a skilled workforce in the area of national security, thereby contributing to economic growth.”
Cybersecurity

Defense against the darkweb

Paulo Shakarian, a Fulton Entrepreneurial Professor, is an expert on the hacker community and the activities in the dark web and deepnet.

Shakarian is also director of the Cyber-Socio Intelligent Systems Laboratory that researches malicious hackers and analyzes their distinct culture. With that knowledge and a team of cybersecurity experts, they're taking a new approach that allows them to detect a threat from hackers before it can do any damage.

**Darknet = computer networks with restricted access**

**Deepnet = websites not indexed by search engines**

Using a machine learning system, Shakarian and his team are able to monitor both darknet and deepnet websites for traffic related to potential hacks, giving software developers a heads-up so they know what they need to protect against. The system is currently able to monitor roughly 120 sites at once. It's the first technology to be able to do so at such a scale, and as Shakarian reported, to allow for the identification of hackers who have a presence on multiple sites and products that are duplicated on multiple sites.

“The information we’re getting is much, much richer,” he says. “And we think that’s really the key to solving this problem. You can’t just pick one hacker site [to monitor] at random when there are so many out there. You have to have a more comprehensive view.”

Their approach works by crawling both hacker marketplaces and forums for exploit-related content, then parsing out that which is related specifically to hacking threats.

The machine learning system approach allows them to filter out that content by doing exactly what it sounds like: It learns which content to look for. It does so through a small bit of initial human content tagging. From there, the system continues its search automatically in the future.

This system’s technology is licensed to IntelliSprye Incorporated, a spinout company led by Shakarian. Another effort sponsored by ASU is combining game theory and data mining to aid in the defense against cyber attackers who leverage zero-day exploits and will bridge his research efforts in both cybersecurity and social networks.

Gearing up to handle “big data”

Shakarian’s social network research is supported by three Department of Defense grants to study social influence, the inhibition of information cascades and cyber-attribution. He also received a Defense University Research Instrumentation Program to replace inefficient equipment with new workstations.

“The main bottleneck we had was that we wanted to do more analysis on ‘big data’ by loading all of the datasets into memory,” Shakarian says. “For instance, we do work on social influence and want to study the retweet history of millions of tweets — this works much better if we can keep all the data in memory instead of accessing the hard disk, which is a much slower operation.”

Paulo Shakarian recently shared his expertise at a panel led by Estrella Mountain Community College and the Southwest Valley Chamber of Commerce to help advise local businesses in ways to stay secure in an increasingly digital marketplace — an important activity when software companies disclose approximately 15,000 vulnerabilities every year.

Along with other speakers and experts from ASU, the private sector and government, Shakarian advised awareness of the environment, as well as a good plan, are the keys to success in cybersecurity.
Stephanie Forrest, a professor and director of the ASU Biodesign Institute Center for Biocomputing, Security and Society, has more than 20 years of experience leading interdisciplinary research at the intersection of biology and computation, including work on computer security.

“She says computer scientists can learn from human immune systems and biological evolution to enhance computer security.

“Looking at how biological systems have learned to protect themselves can suggest novel approaches to security problems,” Forrest says. “One of the easiest places to see this is in the immune system, which plays a major role in protecting individual organisms from foreign viruses and bacteria. What I try to do is look at biological mechanisms and principles and translate those mechanisms and architectures into computational algorithms that protect computers.”

An immune system for computers

By 2022, the world may see a cybersecurity workforce gap of nearly two million jobs.

Students interested in filling that gap can enroll in a new NSF Scholarship for Service program at ASU focused on cybersecurity.

The NSF CyberCorps program will accommodate students interested in earning undergraduate or graduate degrees, and all students who enroll will be involved in cybersecurity research.

“Students who enroll can focus on many different areas that influence and build upon cybersecurity, including artificial intelligence, machine learning, networking, embedded devices, and more,” says Adam Doupé, assistant professor and associate director of the Center for Cybersecurity and Digital Forensics.

Routing robocalls

Tired of getting robocalls and robo-voicemail? Adam Doupé is too.

One root of the problem is that caller ID can be easily and inexpensively spoofed, which can trick you into thinking you’ve been called by a legitimate business.

“No one checks the validity of the caller ID field,” Doupé says. “As part of my team’s research, we looked into what tools and techniques have been tried to prevent robocalls and scams, and none have been successful.”

Doupé and his research team have filed for a patent on a technology that shows a security indicator, like the green lock you see in your browser’s address bar, to show if a caller is legitimate and to build trust in the caller ID phone number.

“If you’re on Google or Facebook, you’ll see the lock and know that your communications are secure,” Doupé says. “In my lab’s work, we’re creating a similar mechanism for phone calls to build a level of trust in the caller ID phone number.”

The team is also working with the International Telecommunication Union, a global telecom standardization body, to have this technology standardized.

“You cannot practice defense unless you have a good understanding of offense.”

— Adam Doupé at the first Arizona State University Congressional Conference on Cybersecurity that brought together members of Congress, one senator and representatives from academia, business and the military to debate cybersecurity challenges.
Artificial intelligence and robotics

A slam dunk for machine learning

It shoots, it scores!
New machine learning algorithm teaches robot to shoot hoops in less than three hours.

Henri Ben Amor, an assistant professor of computer science, is using machine learning to teach robots to shoot hoops faster than ever before and to accelerate teaching robots to complete a variety of tasks.

While many robots can take anywhere from two to three days to learn how to execute a given task, Ben Amor created an algorithm that allowed his basketball-throwing robot to learn how to sink a shot in a matter of hours.

His algorithm avoids many drawbacks that currently plague machine learning. Imitating a human has drawbacks due to different anatomy and capabilities, and reinforcement learning can take thousands or millions of hours to learn a task.

Ben Amor’s algorithm, called “sparse latent space policy search,” enables a robot to first understand the coordination between its different joints, parts and movements. Through this, the robot gradually eliminates unsuccessful solutions to arrive at a successful one.

Throwing a basketball also addresses the issue of learning dynamic movement. Often, robots will break a task down into a series of movements: Pick up an object. Rotate the object. Move it five feet to the right. Lower the object toward a receptacle. Release the object. Throwing a basketball cannot be accomplished in starts and stops — it requires a burst of dynamic motion, an elusive feat for many learning robots.

“It requires a robot to dynamically apply force at the right time, straying away from the ‘divide and conquer’ approach common in computer science and machine learning,” says Ben Amor.

It’s inefficient to program each individual movement, accounting for different situations and variables. With Ben Amor’s approach, he can change the ball’s weight or hoop’s height and the robot will make necessary adjustments on its own in three hours or less — no reprogramming necessary.

In an industrial situation, learning can be an invaluable asset in a robot. Rather than requiring a team to completely reprogram the robot every time the product changes on an assembly line, a process that can take days or longer, the robot can make the adjustment itself with just a few hours of learning.

Ultimately Ben Amor wants to create robots capable of machine learning that can quickly adapt to complement their human partners.

Computer vision in Moscow

An ASU student team set out to Moscow to put their skills to the test at VisionHack, the first hackathon for computer vision for autonomous vehicles.

Teams taught a computer to identify six different obstacles: a bridge, a tunnel, windshield wipers, crosswalks, speed bumps and road signs denoting city exits and entrances. The ASU students impressed the judges, earning first place for Best Presentation, Most Original Approach and, fittingly, Most Innovative.

ASU’s team consisted of electrical and computer engineering graduate student Sami Mian, computer science graduate student Daniel D’Souza, software engineering graduate student Alexander Lampis Slaughter and computer science undergraduate students Abhik Chowdhury and Ashley Megumi Satkowski. Jared Schoepf, Fulton Schools alumnus and director of the Engineering Projects in Community Service program, accompanied the team as their faculty mentor.

The key to ASU’s approach was their prioritization, according to Mian.

“We had six different types of obstacles to account for, so we looked at the problem overall and tried to determine which obstacles, if any, would overlap,” says Mian. “We then prioritized the challenges based on what we thought was most critical — that being the crosswalk.”
Human-robot connection

A project designed to “bridge the communication gap” between humans and robots was a finalist in the U.S. Finals of the 2017 Microsoft Imagine Cup, the international student competition that’s considered the “Olympics of Technology.”

Æffective Robotics, composed of computer science doctoral students Tathagata Chakraborti, Anagha Kulkarni and Sarath Sreedharan and mentored by Subbarao Kambhampati, a professor of computer science and engineering and director of the Yochan Research Group, presented a concept — along with software — for the operations of a “factory of the future,” in which robots and humans would be connected through a networking system enabling them to effectively “share a brain.”

The humans and robots share technology that provides platforms for a “mutually understood vocabulary” and for “intention recognition and projection,” allowing everyone and everything connected to the network to anticipate each other’s physical movements and high-level goals, and to comprehend the intentions and motivations behind those movements.

It’s all achieved through what team members describe as a Consciousness Cloud that would give the robots working in the factory “real-time shared access to the mental state of all humans in the workplace.” This setup allows people to infer robots’ actions through holographic projects and communicate their own intentions to factory robots.

An AI mom in the passenger seat

Ashraf Gaffar, an assistant professor of computer science, is developing an AI system that will augment autonomous cars to make driving safer. The system will learn how you drive, then learn on its own and intervene when needed in an intelligent way.

“It will come preloaded with what is good driving and what is not,” he says. “Then the first few weeks it will learn your style of driving and adjust to it. Then it will be able to detect any anomalies and analyze them.”

If you start showing fatigue or suddenly are unable to drive, the car will intervene.

“You can see it as having your mom next to you,” Gaffar says.

AI design and the human-machine

Subbarao Kambhampati and other AI experts gathered at the Computer History Museum to discuss human-machine collaboration and how it affects the way AI tools are designed and developed.

Watch the video: scan the QR code or visit links.asu.edu/CHMAvideo
Andrea Richa, a professor of computer science, is helping develop a nature-inspired “amoebot” to explore programmable materials — a smart network of self-organizing particles that can monitor and respond to their environment.

Her role in a collaboration with colleagues at the Georgia Institute of Technology and the University of Paderborn in Germany is to develop the computer science theory and distributed algorithms necessary to explore and broaden the possibilities of using programmable matter.

Distributed algorithms run concurrently on several independent, interconnected computational devices that cooperate via local interactions, without centralized control.

In using programmable matter, she says, “It’s important that the distributed system is able to self-organize, so that it does not require any central control or human intervention, and that it achieves the desired behavior by means of local interactions of the computationally limited sensors.”

She and her research group developed a theory for a system of self-organizing particles that can perform universal coating and compression — meaning the particle layer is even and tightly gathered — with only local communication and limited information about the environment. For example, the particles are able to perform these processes without having to rely on a global coordinate system, or any global orientation that they all share.

The findings were based on work with the University of Paderborn to develop a framework to describe programmable matter systems, which they call the “amoebot model” based on its amoeba-like movement.

Using the model, Richa and her associates addressed the problem of coating surfaces of any shape through their universal coating algorithm for programmable material that “is indifferent to the shape or size of the surface that it must coat,” she says.

Through collaborations with Georgia Tech Professor Dana Randall and doctoral student Sarah Cannon, Richa’s group collaborated with Georgia Tech to construct and analyze a new compression algorithm that enables system behavior similar to that of ants and other insects when they swarm to collectively carry out tasks.

Improved compression would likely help tiny particulate sensors not only perform better at gathering information but also improve their communication with each other, enabling them to work faster in some cases.

Srija Chakraborty, a computer engineering doctoral student, researched satellite data analysis at a summer program at the NASA Jet Propulsion Laboratory Center for Climate Sciences hosted by Keck Institute for Space Studies, Caltech and JPL.

Chakraborty’s research interest lies in developing improved machine learning and signal processing algorithms for remote-sensing data analysis.

“Right now, we have more data than what we can understand or forecast correctly, and I would like to study ways to analyze and handle such data from satellites in an integrated manner,” Chakraborty says. “As of now, we do not have a high variety and volume of data from other planets in our solar system as well as exoplanets. I hope that future missions would fill in this data void, and I hope to contribute to the analysis and understanding of such environments for supporting deep space missions.”

Chakraborty conducts her research in the IMPACT Lab (short for Intelligent, Mobile, Pervasive, Autonomous, Computing and Communication Technologies), which is directed by her doctoral studies supervisor, Professor Sandeep Gupta, director of CIDSE.
**Turtle inspires robot**

The turtle-like shell and flippers were no accident on a robot developed by a team of Fulton Schools researchers.

C-Turtle was intentionally designed with inspiration from biology in mind.

C-Turtle, which moves in sandy environments, took one hour of learning to walk in the sand in a desert test. The biology-inspired, curved design worked better than squared edges, demonstrating how biology can short-cut problems in robotics.

"If we use tricks from nature, it learns much faster," Heni Ben Amor, an assistant professor with AI expertise, says. “You can use that initial inspiration from nature to get things going."

Ben Amor and his team worked on the machine learning aspects of C-Turtle. He collaborated with faculty members and students from different backgrounds: computer science, mechanical engineering and biology.

Ben Amor teamed up with Daniel Aukes, an assistant professor of engineering in the Polytechnic School whose background is in designing, fabricating and building robots, to manufacture the turtle-inspired robot.

**French exchange connection**

Imane Lamrani, a doctoral student in computer engineering, was one of only 10 American computer science and computer engineering doctoral students chosen for a summer session of the French-American Doctoral Exchange Program organized by the Office for Science and Technology of the French Embassy in the U.S.

The theme was cyberphysical systems and their applications, one of the major thrusts of Lamrani’s research pursuits.

Workshops and demonstrations covered an array of endeavors in computing systems, information technologies, image and signal processing, control systems, cybersecurity and human-robot interaction, as well as “smart” systems, including “smart home” technologies.

Lamrani conducts her research in the IMPACT Lab (short for Intelligent, Mobile, Pervasive, Autonomous, Computing and Communication Technologies), which is directed by her doctoral studies supervisor, Professor Sandeep Gupta, director of CIDSE.

**Programmable robot wins first prize at Intel Cup**

A student team led by faculty member Yinong Chen won the Intel Cup in China programmable robot project.

Chen’s four students set out to create an alternate programming environment for the robotics concentration of CIDSE’s introductory class, FSE 100.

The team created a drag-and-drop visual programming language called VIPLE — Visual IoT/Robotics Programming Language Environment — and also built a custom robot hardware kit for students to use. The robot is made of custom-designed parts, Intel boards and middleware software they created themselves.

“Our goal with VIPLE is to provide a language we can use to teach introductory-level students computational thinking such as providing a focus on algorithms or higher level programming concepts without having to focus on the detailed syntax,” says Gennaro De Luca, a computer science student. “We also developed the middleware that a user could install on an Intel board and be able to easily communicate with VIPLE and program that robot.”

De Luca led the software team and developed the VIPL software. Sami Mian, a computer systems engineering student, was in charge of the hardware and designed the robots and all of the custom parts for the project. John Robertson, an electrical engineering and computer science student, was in charge of the middleware that helped bring the other two teams together. Tara De Vries, a computer science student, worked on the software team.

ASU won a second prize in 2012 and now has first prizes in each of the past two competitions in 2014 and 2016.
Life-changing research before college

The Center for Cognitive Ubiquitous Computing, or CUbiC, provides research opportunities for ASU students as well as high schoolers looking to get a jump start on conducting research.

As a senior at BASIS Scottsdale, Shreya Venkatesh took full advantage of the opportunity to work with a CUbiC research team — and won several awards in the process.

Under the mentorship of Troy McDaniel, an assistant research professor, and Arash Tadayon, a computer science doctoral student, she helped create a wearable device to help individuals with Parkinson’s Disease manage a common symptom known as Freezing of Gait, or the sudden inability to continue their walking stride.

Auditory and visual cues have been previously used to guide the user to take longer steps, but the CUbiC team’s approach explores the field of haptics, specifically sensory vibrations as a feedback tool.

“Using something artificial like technology to influence something as natural as human illness is fascinating,” says Venkatesh, who has enjoyed seeing up close the way technology can be employed to help improve human health.

Venkatesh received a Young Scientist of Arizona Award from Phoenix Comic Fest at the Arizona Science and Engineering Fair — a state-wide science fair competition — for her research in the Freezing of Gait events. Two months later, she was invited to present a talk on this research area at a Phoenix Comic Fest panel. She also earned an Outstanding Young Female Scientist in Systems Software award from the Association for Women in Science at AzSEF.

Improving energy efficiency and cybersecurity in manufacturing

Rene Villalobos, an associate professor of industrial engineering, leads one of 28 Industrial Assessment Centers funded by the Department of Energy’s Office of Energy Efficiency and Renewable Energy.

The DOE awarded ASU $1.5 million in 2016 for the five-year project with $35 million in total funding that seeks to help make the U.S. manufacturing industry more energy-efficient, productive and secure.

IACs make site-specific recommendations to improve efficiency while providing undergraduate and graduate students the opportunity for first-hand exposure to industry manufacturing processes, energy assessment procedures and energy management systems. IAC assessment teams of faculty and students take measurements, come up with improvement ideas and calculate cost savings. The hands-on experience helps students learn what really matters to industry and leads to better-qualified graduates, which the DOE says the U.S. lacks.

The ASU IAC conducts free assessments for small manufacturers with fewer than 500 employees, gross annual sales below $100 million and energy bills between $100,000 and $2.5 million per year in Arizona, southern Nevada/Las Vegas and western New Mexico.

As an independent and experienced third party, ASU provides unbiased assessments on energy efficiency plant managers can use to justify capital expenditures. The ASU IAC also provides analysis of a manufacturer’s cybersecurity strengths and weaknesses and recommends security measures to protect against cyber attacks.

The ASU team also partners with local organizations — Arizona Commerce Authority business improvement and training organization RevAZ, sustainability and efficiency evaluator Lincus Inc. and industrial consulting organization Nevada Industry Excellence — to identify potential clients and works with power companies to identify energy efficiency improvement opportunities.

Apps for students, by students

Computer science major Jiaqi Wu and computer systems engineering majors Farah Al Yasari, Diana Chen and Derek Fermaint spent more than 24 hours hacking together an innovative solution to the 2016 HackMIT competition’s software and hardware challenges. Their apps included an organization app for student organization leaders and a wearable internet of things app for students pulling all-nighters.
Virtual lab startup advances learning capabilities

As the Fulton Schools computer science program grew, Associate Professor Dijiang Huang needed a way to grow his laboratory space for students taking computer networking and cybersecurity courses.

Instead of keeping a physical lab space equipped, maintained and scheduled, Huang began creating a cloud-based virtual lab, where the physical computers and network connections could be emulated on a server to form any computer network configuration needed.

Huang’s virtual lab was a success with his own students, which encouraged him to think about commercializing his platform to benefit a wider range of instructors and students.

Out of these efforts came the startup Athena Network Solutions, LLC and its product, ThoTh Lab.

ThoTh Lab is a browser-based virtual lab environment where instructors can create customized lab configurations in the cloud for personalized and collaborative learning, while saving the cost and time associated with setup and maintenance of physical labs. Students get hands-on experience with computing resources that closely resemble real-world systems, which translates to better problem-solving skill development that will make them competitive in today’s job market. ThoTh’s hands-on lab service tools also allow instructors to more easily manage courses and track student progress and performance.

Cybersecurity startup a finalist in Cisco competition

Fulton Entrepreneurial Professor Paulo Shakarian’s IntelliSpyre company was one of only six finalists selected from among more than 5,500 business startups from more than 150 countries that entered the Cisco Innovation Grand Challenge in 2016.

The competition is aimed at finding three of the most worthy ventures led by digital technology “trailblazers” for the Cisco company to reward with funding and other startup support.

IntelliSpyre is a cybersecurity startup focused on identifying cyber threats from malicious hackers in the earliest stages. It leverages cutting-edge technology to help businesses ramp up their cybersecurity systems.

The company utilizes both human analysts and advanced machine learning capabilities to search portions of the internet — including the aptly named “darknet” — where malicious hackers organize, plan, purchase malware, sell exploits and conduct other activities prior to conducting a cyberattack.

The software records specific threats to a given client in a database, which is then analyzed using advanced artificial intelligence and machine learning techniques.

Throughout the process, analysts review the information for both quality control and to conduct further human-based analysis.

“This provides corporate security professionals the means to take early action and avoid cyberattacks altogether,” says Shakarian.

Shakarian has received support for his venture from both ASU and The Armory Incubator, a group that supports veteran-led enterprises. Shakarian is a U.S. Army veteran.

Student helps refugee families get access to computers

Computer systems engineering student Louis Ship worked with health care industry professionals and a health sciences student to create PCs for Refugees.

The team collects donated personal computers and laptops, refurbishes them and distributes them to Syrian refugee families who have settled in metro Phoenix. They also provide training to the families who receive the computers. To provide internet access, PCs for Refugees works with Cox Communications, which has a program to provide low-cost internet service to low-income families.

Their goal is to help individuals overcome the limitations that come with lack of computers, including doing homework, job searches, applications for scholarships and accessing resources. They also help the families learn English by providing English-tutoring software and educational and professional programs on the computers.

PCs for Refugees earned one of three finalist spots in Pakis Social Entrepreneurship Challenge, a competition to find the team with the strongest potential to solve a social challenge.

Students

Riad Sbai, ASU alum and founder and president of PCs for Refugees, shows a family how to use new programs on their donated computer.

Photo: Abdul Rahman Bayazid | The State Press
Startup innovates the parking space

With many major universities nationwide charging $500 or more per year for parking, two students at ASU created a company to alleviate stress associated with finding affordable parking options near campus.

Scott Fitsimones, a computer science student, worked with a physics and economics major to create AirGarage, an online marketplace for people to list, find and book parking spaces in Tempe, Arizona.

For example, a homeowner with enough room in a driveway for an extra car could list that spot and a driver needing to park in that area could rent it. The students are striving to generate value for both parties by creating a market for extra space on private property that may not have previously been thought of as available parking.

AirGarage earned the SRP Innovation Award and $20,000 in the ASU Innovation Open as the third-place team.

Computer science faculty break barriers to diversity

Carole-Jean Wu, an assistant professor of computer science, says doubts over belonging are prevalent among some computer science female students who make up only 15 percent of the major at ASU.

As a result, “We have really bright students who don’t stay” in the program, Wu says, adding that the number of female faculty members in the program is also comparatively low, limiting the role models and future prospects female students see. To try to change that situation, Wu and some of her faculty colleagues have established and maintained support for a scholarship program to send many of the women in the Fulton Schools computer science program to the annual Grace Hopper Celebration of Women in Computing. The event produced by the Anita Borg Institute for Women in Technology and presented in partnership with the Association for Computing Machinery is the world’s largest technical conference for women in computing, drawing more than 15,000 participants from more than 60 countries.

With a grant from the Anita Borg Institute’s Building, Recruiting and Inclusion for Diversity initiative, and additional support from CIDSE and ASU’s Global Security Initiative, 50 of ASU’s female computer science students were able to earn scholarships to make the trip to Houston, Texas, for the 2016 Grace Hopper conference. At least 10 additional ASU students attended, some with support from companies for which they work as interns.

The event features leaders in the field, from industry, academia and government, presentations on research, opportunities for networking and mentoring, professional development sessions and a career fair for those seeking jobs and student internships.

Students who attended are emphatic that their profession will contribute more to society if its practitioners are more diverse. Wu has strong support from other ASU computer science colleagues to aid the cause of retaining women in the program to develop the Grace Hopper scholarship program, a Women in Computer Science student club, mentoring opportunities and to raise awareness of the need for women in computer science.

A supernova of innovation, Silicon Valley has been drawing the brightest, most creative employees for decades. And increasingly, those workers include Arizona State University graduates.

ASU recently made Business Insider’s list of the top 20 universities for landing a job in the high-tech mecca, and a different analysis, by the online recruiting company HiringSolved, put ASU in the top 10 for sending the most graduates to Silicon Valley.

These accolades are not surprising for a university that was named most innovative in the nation three years in a row, according to a survey of peers published by U.S. News and World Report magazine.

Alumna Varsha Iyengar, ‘16 master’s in computer science, now works at Google as a contractor doing motion-capture analysis for Project Soli, a radar chip that analyzes hand gestures and movement. She cites her research at ASU as a tool that helped her get ahead.
Innovative ideas make an impact

CIDSE students applied the entrepreneurial mindset to make up four of 20 student-led startup finalists in ASU's Edson Student Entrepreneur Initiative in the 2016-2017 academic year.

Projects included Fusion Folder, a folder that attaches to the back of a laptop to store documents; Hygeia, an internet of things platform for efficient waste-management schedules; Knoze, a note sharing and organizing platform; and Distinguished Gentleman's Club, a subscription box fashion service for big and tall men.

Complex network: Interdisciplinary experts model policy outcomes

An interdisciplinary team of researchers at ASU is creating a tool to help policymakers make sustainable choices for the future of food, energy and water.

These three resources are inextricably connected, as residents need water for drinking, and water is used to irrigate crops, generate energy and cool power plants. When water levels decrease, it not only affects consumers but agricultural and energy sectors as well.

Successful policy in all sectors takes into account the links, synergies and conflicts between them through anticipatory governance — using data and models to predict how variations will affect our world and how we can proactively plan for the consequences through policy.

This five-year, $3 million NSF Award from the Innovations at the Nexus of Food, Energy and Water Systems program is led by Ross Maciejewski, an assistant professor in computer science, with co-principal investigator Hessam Sarjoughian, an associate professor of computer science, in collaboration with three other ASU faculty.

“The areas are so broad you can’t just be an expert in one discipline,” Maciejewski says, “so we rely on others to bring their expertise.”

Maciejewski is an expert on data visualization, Sarjoughian in heterogeneous modeling methods, and others bring expertise in hydrology, water resource engineering, environmental policy, stakeholder engagement, economics and sustainable food systems.

With the help of these experts, computer scientists Maciejewski and Sarjoughian create visualization tools that display the model simulation data in a way that is accessible to individuals outside their domain of expertise.

By creating a way for stakeholders to understand the feedback between the food-energy-water nexus biophysical systems and related economic systems, policies can avoid significant undesirable and unintended consequences.

Ted talks innovation at TEDxASU talk

Ted Pavlic, an assistant professor, presented on the idea of blurring traditional disciplinary lines to foster innovation between researchers of all fields as a speaker at TEDxASU in 2017, an independently organized TED conference-format event.

Watch Pavlic’s talk in its entirety: scan the QR code or visit links.asu.edu/tedxasutalk

Foiling malicious agents with a moving target

Computer science doctoral student Ankur Chowdary has earned more than $1.8 million in grants — including from the DoD — to research a system that can predict cybersecurity attacks and move data around the cloud.

With network security system AVMSec, if a user is identified as secure, they get access to a security key. However, users identified as suspicious get a “shell game” instead.

“For them, the data is moving around very fast in the cloud, and it’s difficult for them to do any malicious act in the system,” Chowdary says.

AVMSec added another $20,000 in cash and $2,500 in services including accounting help, marketing and space as a finalist at the New Venture Challenge entrepreneurial competition. Chowdary predicts a revenue of $100 million by 2021.
ASU's student chapter of the Institute of Industrial and Systems Engineers started the 2017-2018 school year strong — it was awarded Gold Status by the IISE what the student group has done to benefit its members.

Last year, the chapter's leadership organized career-fair preparation sessions, hosted luncheon events to build relations between students and faculty, partnered with other student clubs to present a “lean manufacturing” workshop and provided scholarships for national IISE memberships and travel to regional and national conferences.

The ASU chapter's accomplishments “have been a team effort, the entire leadership team deserves the credit,” says Daniel McCarville, an industrial engineering and engineering management professor of practice who has been the student organization's faculty advisor for the past three years.

Earning the gold for outstanding service to students

Subbarao Kambhampati and Sethuraman Panchanathan are among the 396 newly elected fellows of the American Association for the Advancement of Science, the world's largest general scientific society.

Becoming a fellow is in recognition of efforts toward advancing science applications that are deemed scientifically or socially distinguished. Within that general framework, each awardee is honored for contributions to a specific field.

Subbarao (Rao) Kambhampati, professor — Kambhampati’s contributions to automated planning and human-aware artificial intelligence systems, and for leadership and service to the AI community have earned his election. His current research focuses on challenges in facilitating effective, trustworthy and collaborative interactions between humans and AI agents (e.g., robots). Kambhampati also is the president of the Association for the Advancement of Artificial Intelligence, which promotes research in, and responsible use of, AI.

Sethuraman (Panch) Panchanathan, executive vice president and chief research and innovation officer, Office of Knowledge Enterprise Development — AAAS recognized Panchanathan’s distinguished contributions to the field of human-centered multimedia computing and for national leadership in research, science, technology and innovation. Panchanathan’s research interests include development of haptic-user interfaces, person-centered tools and ubiquitous computing technologies for enhancing the quality of life of people with disabilities. In his current role, he oversees ASU’s $500 million research enterprise and serves on several national research councils, including the U.S. National Science Board.

The Institute of Industrial Systems and Engineers, the premier professional society for industrial engineering, bestowed professor Ron Askin with 2017’s Albert G. Holzman Distinguished Educator Award.

“I feel greatly honored to be included in the list of educators that have received IISE’s Albert G. Holzman Distinguished Educator Award,” said Askin. “It’s both humbling and thrilling as many of the previous winners have been role models for me.”

This marks the first time a faculty member of the Fulton Schools has earned the award since its inception in 1986. Named for the late Albert Holzman, an accomplished industrial engineer at the University of Pittsburgh, the award recognizes educators whose notable contributions to industrial engineering are evident through teaching, research and publication, extension, innovation or administration.

Askin served as director of CIDSE from 2009 to 2016, before stepping down to return his focus to education.

“Being a professor is a privilege that comes with great opportunity and responsibility for shaping the next generation of industrial engineers that will lead economic development and contribute to society,” he said.

Recognition

Askin recognized with Distinguished Educator Award

Two faculty elected fellows to prestigious scientific society
In her research, computer science doctoral student Bing Si developed data fusion and system informatics approaches that can improve the quality and performance of health care systems, from diagnosis to care to system-level decision-making.

Health care is now a data-rich environment, thanks to technology advancements in diagnostic imaging, smart sensing and health information systems.

“It is now possible to track every piece of information related to a patient’s diagnosis, treatment and care,” Si explains. “This offers a great opportunity for precision medicine: the ability to offer the right medical decision to the right person at the right time.” But, she adds, the size and complexity of the data overwhelm the modeling capability of existing statistical methods.

In her dissertation, Si focuses on the emerging problems in health care and develops novel statistical models and machine learning algorithms to tackle these problems. Her work could impact the understanding of conditions, such as migraine disorder and traumatic brain injury, and could lead to personalized diagnostic biomarker optimization for Alzheimer’s disease. It might also enable joint data mining of electronic medical records and hospital operational data to improve the quality and safety of health care delivery.

Si’s advisor, Associate Professor Jing Li, is co-director of ASU-Mayo Center for Innovative Imaging. She said Si is a leader in the lab and has won the Grace Hopper Award for her role in championing female and minority students in analytics, computing and health care. Li added Si has already published in premier journals, and “her research has also generated translational impact on medicine and health care.”

“Because of the caliber of our doctoral students, selecting the recipients for the Dean’s Dissertation Award is one of the most difficult things we do each year,” said Kyle Squires, dean of the Fulton Schools. “[Bing] is an excellent student, and making significant contributions in the way technology, particularly big data, impacts the lives of all people.”

Mirchandani earns IEEE Fellow

Professor and AVNET Chair in Supply Chain Networks Pitu Mirchandani has been granted IEEE Fellow status for “contributions to stochastic dynamic networked systems in intelligent transportation and production systems.”

IEEE is the world’s largest organization of technical professionals.

His work in those areas reflects his broader expertise in the management of complex networked systems, which aids planning and decision making under conditions with uncertainties and random variations.

He’s considered a pioneer in integrating the use of advanced modeling, information technologies and data-driven decision-making tools into transportation and logistics operations. His modeling ideas have explored applications in optimizing energy systems, water distribution systems, urban infrastructure planning and development, land use and health care.

Mirchandani is also a Fellow of the Institute for Operations Research and the Management Sciences.
Industrial engineering grad pilots way to top-tier flight school

James Boulton remembers dressing up as a fighter pilot for Halloween when he was in third grade. A dozen years later, he’s ready to zip up his flight suit, put on his aviator glasses and jump in the cockpit.

Boulton started out as an aerospace engineering major “because I thought that would help me get a pilot slot in the U.S. Air Force.” After learning the Air Force cared more about a GPA than a specific major, he met with an advisor who recommended industrial engineering — a field that would tie together his passion for business, finance and math.

Boulton changed majors and never looked back. He was a Dean’s List recipient eight times and graduated summa cum laude.

And he is one of a handful of Air Force ROTC cadets in the nation recently selected for the highly competitive Euro-NATO Jet Pilot Training program at Sheppard Air Force Base in Wichita Falls, Texas. He’ll be the first ASU graduate to be part of the program in eight years.

“I’ve prepared my whole life for this moment,” Boulton says. “I’ve earned a really good degree in something that I love from a school that prepared me very, very well.”

Visualization research earns students international recognition

Research in areas ranging from visual analytics and self-organizing particle systems to machine learning and computational genetics has earned some international recognition for ASU students Alexandra Porter and Rolando Garcia. They’re among 37 undergraduate students from colleges and universities throughout North America to recently receive accolades from the Computing Research Association for demonstrating outstanding computing research skills.

Porter, an honors student majoring in computer science and mathematics, with a minor in music performance, was a finalist for one of the top honors bestowed by the Computing Research Association’s 2017 Undergraduate Research Awards program in the category for women at institutions that grant doctoral degrees.

She worked on a nutrition visualization research project with Ross Maciejewski, an assistant professor of computer science, in his Visual Analytics and Data Exploration Research Lab. She created an Android app that enables users to record what they eat and then visualize data about their diets. She co-authored and presented a research paper titled “A Survey of Personal Nutrition in mHealth Nutrition Apps” at the international Person Visualization Workshop organized by the IEEE.

She also worked on self-organizing particle systems with computer science professor Andrea Richa and on creating a simulation of an internet-connected self-driving wheelchair with Umit Ogras, an assistant professor of electrical engineering.

Porter says these varied accomplishments have made her confident that she is well prepared for her pursuit of a doctoral degree in computer science and a career in research.

Garcia is a senior majoring in computer science. He earned an honorable mention in the men’s category.

As a research aide in Maciejewski’s VADER Lab, Garcia has been involved in developing technologies to help people understand and work effectively with large sets of data.

He presented findings from his work at two national research symposiums and at an IEEE workshop. For the workshop presentation, his research team earned the Visual Analytics Science and Technology Grand Challenge Award for Outstanding Comprehensive Submission.

Last summer, Garcia was a research intern for the Computational Genetics Laboratory at the Institute of Biomedical Informatics at the University of Pennsylvania. He worked on projects involving Deep Learning architectures, one of a set of machine learning methods based on representations of data.

“My long-term research goal involves studying data structures for achieving fast machine learning at bigger scales,” Garcia says. “The aim is to find out how a computer could become capable of organizing and accessing information so that it can be at least as intelligent as we are.”

Finding funding for novel research ideas can be challenging. ASU and Mayo Clinic are addressing this challenge.

For 13 years, the Mayo-ASU seed grant program has funded — or seeded — promising new research collaborations between ASU and Mayo Clinic researchers aimed at improving patient care. A seed grant is like startup funding for research — the intent is to launch novel research on a small scale to attract the funding needed for a larger study.

Associate Professor Jing Li and Catherine Chong of the Mayo Clinic were one of the research teams selected for funding in the 2017 Mayo-ASU seed grant program with their project, “Sex-specific profiles of white matter repair following concussion: A longitudinal diffusion tensor imaging study in young athletes.”

In addition, Li was one of eight Alliance for Health Care Fellows chosen to be part of the inaugural Faculty in Residence program between Mayo Clinic and ASU. During the summer 2017 residency, Li used multi-contrast, MRI-based tumor-density maps to guide surgical resection of glioblastoma and improve patient outcomes.

“I’m looking forward to strengthening the collaboration and establish a program between ASU and Mayo with leading-edge research and education enrichment on the interface between data science, mathematical oncology and quantitative imaging,” Li says of her residency.
**Degree programs**

**Undergraduate degrees**

The Bachelor of Science in Engineering (BSE) in **computer systems engineering** focuses on the systems that enable computation and communication and the integration of systems software and hardware. It emphasizes the design and development of hardware and software components comprising a computer system. The curriculum includes courses on computer organization and architecture, system programming, operating systems, embedded microsystems and digital hardware design. Although the program addresses numerous application areas, a unique focus on embedded systems sets it apart. A concentration in information assurance is also available.

Accredited by the Engineering Accreditation Commission of ABET. www.abet.org

The Bachelor of Science (BS) in **computer science** has its foci on computational processes for problem solving, and information transfer and transformation with an emphasis in improving software and system quality, security, performance and usability. It provides a solid background in computing principles and enables students to customize their degrees with technical electives. Students may also select courses in mathematics, other engineering areas and biology to meet requirements. This degree also offers a software engineering concentration of courses in which students have an opportunity to master software development techniques while working in teams. A concentration in information assurance is available for this degree as well.

Accredited by the Engineering Accreditation Commission of ABET. www.abet.org

The Bachelor of Science in Engineering (BSE) in **engineering management** prepares students to effectively lead engineering-driven enterprises. The curriculum provides a breadth of engineering science and design with depth in one practice area. Study of business practices, organizational behavior and management skills are emphasized. Topics such as project and resource management, financial engineering, risk management, configuration management, service plans, product liability, entrepreneurship and operations management are covered in addition to product design and process development. Graduates will be employable as project management team members, system specification and customer relationship management specialists, production supervisors, supply logistics engineers or similar roles.

Accredited by the Computing Accreditation Commission of ABET. www.abet.org

The Bachelor of Science (BS) in **informatics** provides an interdisciplinary experience that responds to the rapidly growing need for skilled informaticians that focus on how people use information. With the tremendous growth in knowledge about computation and its application, informatics represents a large and growing body of knowledge that fits in between disciplinary majors to help utilize computing technology in specific problem domains. Students in the program learn various subjects in software engineering, human-computer interaction, decision theory, organizational behavior and information technology infrastructure. Graduates will develop innovative ways to help people interact with technology and new ways for users to create and share information and to design computational tools that model, aid or automate activities within disciplines such as science, business, geography, education and entertainment.

Accredited by the Engineering Accreditation Commission of ABET. www.abet.org

The Bachelor of Science in Engineering (BSE) in **industrial engineering** is ranked among the top 20 in the nation. The program concentrates on the design, operation and improvement of the systems required to meet societal needs for products and services. Students complete 33 hours of upper division industrial engineering courses, three semesters hours of technical electives and nine hours of career-focused study area electives. Undergraduates learn to apply systems modeling and analysis skills to ensure that high-quality products and services are achieved with the optimal use of resources.

Accredited by the Engineering Accreditation Commission of ABET. www.abet.org

The Bachelor of Science (BS) in **software engineering** is a unique project-driven curriculum, establishing a new model for software engineering education. The program is built around the concepts of engaged learning, discovery-based education and learn-by-doing. Students complete projects in every semester of the program to provide emphasis on communication, teamwork, critical thinking and professionalism. Students have flexibility in designing their course of study; they select a software engineering application area such as web applications, mobile systems, or graphics and game development, as their primary focus, and may obtain interdisciplinary knowledge through a secondary area of their design.

Accredited by the Engineering Accreditation Commission of ABET. www.abet.org

**Master’s degrees**

The Master of Science (MS) in **computer science** is a research-oriented degree targeted at students with an undergraduate education in the science of computation. It provides advanced coursework and emphasizes student research as well as offering numerous opportunities for interdisciplinary study. Within this degree, a concentration in arts, media and engineering is offered in collaboration with faculty in the electrical engineering program and the Herberger Institute for Design and the Arts. Master’s students can also pursue concentrations in information assurance and biomedical informatics.

The Master of Computer Science (MCS) is an advanced degree targeted at students with an undergraduate education in **computer-related disciplines** who can benefit from further breadth and background. The program also provides an opportunity for students employed in industry to seek advanced education in computer science. MCS students can pursue a concentration in information assurance. The graduate-level course work emphasizes research topics of current interest, such as embedded systems, information assurance and computer security, multimedia and the arts, database systems, algorithm design and analysis, bioinformatics, sensor and ad hoc networks, data mining, information integration, optical networks and computer aided-geometric design.

Accredited by the Engineering Accreditation Commission of ABET. www.abet.org

The ASU Online MCS is an affordable, 100% online degree offered on Coursera's platform. engineering.asu.edu/online-mcs
The Master of Science (MS) in **industrial engineering** is designed for students interested in combining knowledge from the physical, mathematical and social sciences to design efficient manufacturing and service systems that integrate people, research, production and supply-chain logistics and enterprise information systems in challenging manufacturing and service environments. Successful industrial engineering concepts are also spreading to the financial, logistics and health care services industries, affording new areas of opportunity for graduates. Students choose from a non-thesis or thesis track in the program.

The Master of Science (MS) in **computer engineering** degree combines resources from CIDSE and the School of Electrical, Computer and Energy Engineering. The program provides the knowledge and skills necessary to advance and develop new paradigms for the design, computing, communications and networking (wired and wireless), control functions, sensing, signal processing and actuation. It’s a multidisciplinary program that builds on the fundamentals of computer science, electrical engineering, industrial engineering and applied mathematics, with a balance between hardware and software courses.

The Master of Science (MS) in **software engineering** program focuses on developing advanced knowledge and abilities in the design and application of software. Students will learn to apply engineering principles to software development, including design methodologies, operation principles and maintenance and testing approaches. The program involves the application of engineering principles to software development including design methodologies, operation principles and maintenance and testing approaches. It’s aimed at developing professional skills in this discipline as well as providing opportunities for students to engage in and develop research abilities.

**Doctoral degrees**

The Doctor of Philosophy degree (PhD) in **computer science** prepares students to undertake fundamental and applied research in computer science in academia, government and industry. Having matured as a discipline in its own right, computer science is now interacting at a new level with other fields, not just in engineering and science but throughout the arts and humanities, education, law, medicine and business. A wealth of experience for computer science doctoral students is available through collaborations with other engineering schools in the Fulton Schools, the Herberger Institute for Design and the Arts, the Center for Embedded Systems and the Translational Genomics Research Institute. The interdisciplinary strength of the degree is enhanced by a concentration in arts, media and engineering, as well as a concentration in information assurance.

The Doctor of Philosophy degree (PhD) in **industrial engineering** offers students a program focused on industrial statistics and quality engineering, applied operations research, production and supply-chain logistics and enterprise information systems in challenging manufacturing and service environments. To complement our traditional strengths in manufacturing, in recent years we’ve developed a focus on health systems. The program has a strong track record of placing graduates in academic positions, as well as in leading industrial labs.

The Doctor of Philosophy (PhD) in **computer engineering** is designed for students with excellent skills in mathematics and physical science who are interested in gaining an in-depth knowledge of the foundational principle of engineering, as they pursue a career in academia, research or a highly technical entrepreneurial innovation. The PhD program provides a broader and more in-depth preparation than the MS program, in anticipation of a demonstrated ability to independently pursue more creative and substantive innovation with higher impact. Students may choose to follow a concentration in either electrical engineering or computer systems engineering.

**Certificate programs**

**Computer Gaming Certificate** is an 18-credit-hour certificate open to any student at ASU (undergraduate, graduate and non-degree seeking) and is designed to provide a comprehensive game development skill set that the student can apply to his or her major. The goal is to apply gaming technology to domain-specific problems. The certificate can also be used as one of the areas of concentration for the Bachelor of Interdisciplinary Studies (BIS) degree.

**Informatics Certificate** is defined as the study of ways in which computer technology can be used to gather, synthesize, store, visualize and interpret information. This certificate is available to students in non-computing majors and will provide them with an understanding of the capabilities and technologies of informatics. The certificate can also be used as one of the areas of concentration for the BIS degree.

**Lean Six Sigma Black Belt Graduate Certificate** is aimed at engineers and managers who oversee tactical and strategic projects as well as various operational functions in their organizations. Six Sigma is a proven systematic approach to continuous improvement of critical processes in a wide range of industrial environments such as banks, manufacturing facilities and hospitals. The American Society of Quality defines the Certified Six Sigma Black Belt as “a professional who can explain Six Sigma philosophies and principles, including supporting systems and tools.”

Lecturer Yoshihiro Kobayashi leads a summer study abroad program in Tokyo to teach students visualization and simulation. While his students see firsthand the engineering marvels that run the megacity, they implement a computational tool that integrates multiple systems together, such as traffic logistics, complex train system scheduling and AI-agent systems for crowd management.
Students

Student recognition

Outstanding grads

Fall 2016
- James Boulton
  Industrial engineering
- Ryan Hermens
  Computer science
  Computer systems engineering
- John James "JJ" Robertson
  Computer science
- Alan Zygutis
  Engineering management

Spring 2017
- Ahmad Altheeb
  Industrial engineering
- Cameron Bartee
  Software engineering
- Kevin Liao
  Computer science
- Daniel Martin
  Computer systems engineering
- Hannah Świeczkowski
  Informatics
- Melissa Thomas
  Engineering management

Fall 2017
- Anthony J. Kowal III
  Software engineering
- Nolan Lee
  Engineering management
- Noah Livingston
  Industrial engineering
- Stephen Seidel
  Computer systems engineering
- Richard Tuznik
  Computer science

Convocation Ceremony
Student Speaker
- Raquel Camarena
  Industrial engineering

Dean’s dissertation

Fall 2017
- Bing Si
  Industrial engineering

Impact awards

Fall 2016
- Nichole Emmons
  Computer science
- Nizar Kury
  Computer science

Spring 2017
- Julia Armstrong
  Engineering management
- Patrick Gaines
  Computer science
- William “Phil” Young
  Industrial engineering

In addition to recognizing the Outstanding Graduates and Impact award recipients at Convocation, we also recognize these students for outstanding performance and service.

Outstanding Computer Engineering MS Student
- Zhun Yang

Outstanding Computer Science MS Student
- Sarath Sreedharan

Computer Science Graduating PhD Student of the Year
- Yooseong Kim

Outstanding Industrial Engineering PhD Dissertation Award
- Christopher Wishon

Outstanding TA Awards
- Sylvia Barnai
  Software engineering
- Austin Bren
  Industrial engineering
- Ryan Dougherty
  Computer science
- Yixing Li
  Computer engineering
Undergraduate researchers contribute to creation of new knowledge

Our students have a strong history of participating in the Fulton Undergraduate Research Program (FURI) or the Grand Challenge Scholars Program (GCSP) — two signature programs for the Fulton Schools.

In these programs, students discover the research enterprise — from conceptualizing an idea, developing a plan and investigating the research question to presenting their research outcomes. Starting in their second semester, FURI students collaborate with faculty across disciplines to conduct important research that addresses real-world challenges. Students in this competitive program are also eligible to receive travel grants to present their work at national conferences.

In the Grand Challenge Scholars Program, also known as GCSP, students conduct research in one of 14 grand challenge themes set forth by the National Academy of Engineering. Research is one part of their five-part program.

**Computer science**

**Zachary Ayers**
A Case Study of Natural Language Processing for Human-Robot Interaction

**Lisa Baer**
Creation of Infrastructure for Self-Study of Computer Security

**Daniel Baird**
Assessing Trending Data Sources in Social Media

**Amber Bennett**
Evaluating the Effect of Visual Stimuli on the Intelligibility of Dysarthric Speech

**Diana Chen**
Impact of NAE’s Grand Challenge Scholars Program on Engineering Identity Development

**Justin Clark**
Quantifying Fatigue in EMG Signals

**Zackary Crosby**
Toward Inductive Reverse Engineering of Web Applications

**Aditya Deotale**
Security vs Usability: Impact of Artificial Intelligence on the Society Using Social Media Data

**Scott Fitsimones**
Computer Vision for Environment Mapping

**Scott Freitas**
PathFinder: Rapid Analysis and Visualization of Network Connectivity

**Brandon Gardell**
Smart Reasoning Framework For IoT

**Kiana Ghazouli**
The Impact of Time Constraints on HackerRank Assessments

**William Gibbs**
Canaries in Native Android Libraries

**Anisha Gupta**
Simplifying Self Tracking through the Utilization of Wearable Technology

**Daniel Hill**
Using Dynamic Localization with Holograms to Improve Human Robot Interaction

**James Hutchins**
DarkWeb Marketplace Analysis: TOR and I2P

**Melissa Ip**
Developing Algorithms for Identifying Native Arizona Snakes in Images

**Ryan Jones**
Machine Learning Applications in Speech Therapy

**Michael Kintscher**
Realtime Remote Control Application for Micro-Robots

**Sidharth Kulkarni**
Robot Learning Through Demonstration and Two-Way Interaction

**Kevin Liao**
Next Generation Black-Box Web Application Vulnerability Analysis

**Kevin Lough**
Fault Repair and Self-Avoiding Walks in Self-Organizing Particle Systems

**Nicholas Martinez**
Producing Task-Related Feedback for Lego Mindstorms Programming Activities

**Ethan McDermott**
Threat Intelligence Analysis

**Kevin Mead**
A Comparative Study of Augmented and Virtual Reality in Education of Students with ADHD

**Akhila Murella**
Determining Microcontroller Viability in Point of Care Diagnostics

**Connor Nelson**
Toward Inductive Reverse Engineering of Web Applications

**Calvin Norman**
Integration of Sensors on Autonomous Vehicles for Agricultural Use

**Dhruv Patel**
Effects of Imposing Negative Damping on the Human Ankle

**Jorge Roldan**
Understanding Becoming a Grand Challenge Scholar Engineer

**Jonathan Wasserman**
SCAN: Static and Customizable Analysis for Node.js

**Geoffrey Wong**
Characterizing the Energy Efficiency of Fiducial Tracking on Mobile Devices

**Jiaqiu Wu**
Ringtones: Diverse homosericine lactone systems for cellular communication

**Cory Wyman**
Video Game-Based Motor Rehabilitation

**Coding systems engineering**

**Timothy Huynh**
Developing Autonomous Control for a Motorized Phenotyping Cart for Improved Imaging Quality and Reduced Labor

**Cody Iwertz**
Predicting Cyber Attacks Using a Data Driven Approach

**Luke Mains**
Randomized Algorithmic Construction of Scattering Hash Families

**Stephen Seidel**
Using Locating Arrays for Screening in a Wireless Network Testbed

**Cesar Tamayo Claro**
Design of Collision Avoidance System Using Deep Learning

**Tae Hun Yun**
Internet of Things Pet Care

**Grand Challenge Scholars Program**

**Travel Grant**
Undergraduate research

Engineering management

Ivana Ninkovic
Switchable Adhesive Under Extreme Temperatures

Industrial engineering

Katherine Adams
An Integrated Optimization-Based Tool to Assist Conservation Planning Decisions

Anas Arafat
Student Retention

Alireza Boloori
Data-driven management of post-transplant medications: An APOMDP approach

INFORMS Annual Meeting

Raquel Camarena
Data and Predictive Analytics for Energy Use

Arlen Dean
Guiding Power Grid Investments for Mitigating the Effects of Extreme Weather Events

Craft Labor Productivity Analysis in Civil Engineering and Construction Projects—A Field Experience

Evelyn Holguin
Engineering Mechanical Adventures: A Young Engineer’s Journey to Success

Informatics

Samantha Baker
Robot Interaction: Investigating the Influence of Gestures on Robot’s Social Presence

Software engineering

John Alden
Autonomous Multi-Agent Communication and Coordination Based Upon the Distributed Control Model

Christopher Diaz
Linked Data for Sustainability

Preston Goulet
IMODS

Preston Goulet
IMOD

Sahil Gupta
Context Aware AAC system

Paul Horton
Evaluating Team Cognition Theory in the Hackathon Setting

Radical Collaboration Among Engineering Students During Short-Form Hackathon Events

Grand Challenge Scholars Program

Travel Grant

Andrew Karnes
Bipedal Stabilization Control through Use of an Onboard Neural Network: A Small-Scale Test

Cecilia Laplace
A Study of Self-Regulated Learning in Hackathon Environments

Engineering Students Rapidly Learning at Hackathons

ASEE — American Society for Engineering Education

How Does Self-Regulated Learning Present Itself in Hackathons?

Zachary Monroe
Using Machine Learning to Investigate Password Security

Tyrine Jamella Pangan
1. Developing Engineering Talent Among Navajo Youth with Chain-Reaction Machines and 2. Towards the Development of Culturally-Relevant Engineering Design Curriculum for Navajo Nation Middle Schools

American Indian Science and Engineering Society

Bryan Parrish
Auto-Redaction of Sensitive Information for Law Briefs

Kevin Sidbon
Autonomous Search in GPS-enabled and GPS-denied Environments

Jonathan Wasserman
SCAN: Static and Customizable Analysis for Node.js

Geoffrey Wong
Characterizing the Energy Efficiency of Fiducial Tracking on Mobile Devices

Master’s portfolio students

Student Name/Graduated Position

Andert, Edward
Spring 2017

DocuSign

Bala Subramaniam, Arun
Spring 2016

ASU

Gupta, Mayank
Summer 2017

Metavision

Hu, Sheng-Hung
Fall 2016

Tesla, Inc.

Kadloor, Nikhil
Spring 2016

Kaiige, Nikhil
Fall 2016

Intuitive Surgical

Khan, Zarah
Spring 2018

Space and Naval Warfare Systems and Command

Kury, Nizar
Spring 2017

Samsung Research America

Li-Chi, Huang
Fall 2017

Lobo, Loy
Summer 2017

Madiraju, Naveen Sai
Fall 2018

Mian, Sami
Spring 2018

Mousavi, Seyyedehnasim
Fall 2016

Ruiyue, Peng
Fall 2016

Seville, Travis
Fall 2017

Salt River Project

Steptoe, Michael
Fall 2017

Sur, Indranil
Spring 2017

SRO International

Vementala, Nikhil
Fall 2017

ElementData, Inc.

Venkat Ram, Sudarshan
Fall 2017

Yang, Zhun
Spring 2017

ASU
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<th>Student Name/Graduated</th>
<th>Title</th>
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<td>Agarwal, Shubham</td>
<td>Aligning English Sentences with Abstract Meaning Representing Graphs Using Inductive Logic Programming</td>
<td>Chair: Chitta Baral, Baoxin Li, Yezhou Yang</td>
<td>IBM</td>
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<td>Agrawal, Anurag</td>
<td>Evaluation of a Guided Machine Learning Approach for Pharmacokinetic Modeling</td>
<td>Chair: Sandeep Gupta, Ayan Banerjee, Yogish Kudva</td>
<td>Starbucks Technology Center</td>
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<td>Beejady Murthy Kadecar, Harsha Kadecar</td>
<td>Effects of Error Messages on the Student's Ability to Understand the Error and Fix the Error</td>
<td>Chair: Sohum Sohoni, Shawn Jordan, Scotty Craig, Kevin Gary</td>
<td>Amazon</td>
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<td>Bohara, Bhakti</td>
<td>Moving Target Defense Using Live Migration of Docker Containers</td>
<td>Chair: Dijiang Huang, Adam Doupé, Ziming Zhao</td>
<td>Akamai Technologies</td>
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<td>Cheng, Kowei</td>
<td>Mining Signed Social Networks Using Unsupervised Learning Algorithms</td>
<td>Chair: Huan Liu, Hanghang Tong, Chitta Bara</td>
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<td>Chiarlizeta, Jashmi</td>
<td>Comparing the Impact of Augmented Reality on Social Media: A Case Study of Bangladesh</td>
<td>Chair: Baoxin Li, Baoxian Li, Ian Hsiao</td>
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<tr>
<td>Dani, Harsh Vipulbhai</td>
<td>Sentiment Informed Cyberbullying Detection in Social Media</td>
<td>Chair: Huan Liu, Jinggae Jung, Arthur Glenberg</td>
<td>Ipay</td>
</tr>
<tr>
<td>de Armas, Jadiel</td>
<td>Pingo: A Framework for the Management of Storage of Intermediate Outputs of Computational Workflows</td>
<td>Chair: Rida Bazzi, Violet Syrotiuk, Dijiang Huang, Kurt VanLehn, Arthur Glenberg</td>
<td></td>
</tr>
<tr>
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**ASU-Mayo Center for Innovative Imaging**
The ASU-Mayo Center for Innovative Imaging promotes the collaborative and multidisciplinary effort to bridge engineering research with clinical practices. Researchers in the center strive to improve patient care by developing innovative therapeutic technologies, imaging acquisitions, imaging analytic tools, machine learning and artificial intelligence algorithms, taking a patient-inspired approach.

**Director:** Teresa Wu  
**Website:** amci.asu.edu

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**Industrial Assessment Center**
Faculty and students in the ASU IAC conducts free energy efficiency and cybersecurity assessments for small manufacturers with fewer than 500 employees, gross annual sales below $100 million and energy bills between $100,000 and $2.5 million per year. The ASU IAC serves an area beyond Arizona into southern Nevada/Las Vegas and western New Mexico.

**Director:** Rene Villalobos  
**Website:** iac.engineering.asu.edu

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**Information Assurance Center**
The IAC is a multidisciplinary center focusing on research and educational activities to address the broad issues of developing trustworthy information systems and ensure the quality of information being stored, processed and transmitted by information systems and networks. Our current research activities involve foundational, network, system and application aspects of developing and testing TIS; steganography; facial recognition, video surveillance, multimedia data processing, dynamic and deterministic quality of service management; data mining for security, privacy in data management; and situation-awareness.

**Director:** Stephen S. Yau  
**Website:** ia.asu.edu

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**Center for Assured and SCAlable Data**
CASCADE is solving complex problems through data intensive research and providing informed answers to key societal needs. Our center aims to enable a principled framework for reliable and timely data-driven decision-making and supports the innovation of data architectures and tools that can match the scale of the data.

**Director:** K. Selçuk Candan  
**Website:** cascade.asu.edu

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**Center for Cybersecurity and Digital Forensics**
CDF brings together leading faculty in engineering, social sciences, law and business to conduct research focused on identity management; privacy issues, malware attribution, secure mobile devices, and digital forensics. CDF will promote the invention and commercialization of cybersecurity and digital forensics research. Researchers in the center are working with Starbucks to introduce security engineering principles to students from their first semester through senior projects.

**Director:** Gail-Joon Ahn  
**Website:** globalsecurity.asu.edu/center-cybersecurity-and-digital-forensics

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**iLux**
iLux sheds light on usability issues facing commercial clients by providing accurate and objective consumer behavior gathered with a comprehensive biometric sensor suite that includes EEG, brain computer interface, eye tracking, facial coding and galvanic skin response. The researchers can measure a person’s physical responses to different kinds of stimuli. The lab is part of the adidas-ASU Global Sport Alliance, a strategic partnership aimed at shaping the future of sport and amplifying sport’s positive impact on society.

**Director:** Robert Atkinson  
**Website:** ilux.lab.asu.edu

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**Center for Accelerating Operational Efficiency, A Department of Homeland Security Center of Excellence**
The charge for the CAOE is to support real-time decision-making through the application of advanced analytical tools that enable DHS operational components and other security practitioners to achieve improvements in operational efficiency. Our four major research themes include data analytics, operations research, economic analysis and homeland security risk sciences.

**Director:** Ross Maciejewski  
**Website:** caoe.asu.edu

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**Center for Cognitive Ubiquitous Computing**
The Center for Cognitive Ubiquitous Computing serves the needs of individuals who are physically challenged by empowering them with ubiquitous and pervasive computing technologies to enrich their lives. Researchers in our interdisciplinary research center focus on cutting-edge research targeting a variety of applications, balance technology and a problem-centric view to identify and tackle the target applications that truly require a ubiquitous computing solution.

**Director:** Sethuraman “Panch” Panchanathan  
**Website:** cubic.asu.edu

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**Center for Embedded Systems**
The Center for Embedded Systems is an NSF Industry/University Cooperative Research Center. Our center researches the inner workings of embedded computer systems — special purpose computer systems designed to perform one or a few dedicated functions and are part of a complete device including hardware and mechanical parts. Most people use some form of embedded systems in their daily interactions at work and at home.

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<th>Name</th>
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The ASU Graduate College endorses more than 135 interdisciplinary faculty to chair or co-chair doctoral committees for CIDSE students.
Learn more at graduate.asu.edu
William R. “Bill” Uttal, an emeritus professor of engineering at ASU and emeritus professor of psychology at the University of Michigan, passed away on February 9, 2017.

Uttal was a pioneering researcher in the realm of cognitive neuroscience who authored dozens of important books in his field and more than 140 scholarly articles.

He was introduced to the study of electronics and computing in the Air Force during the Korean War. After the war, he worked in the aviation industry programming computers before deciding to continue his education.

He pursued his doctorate at the Ohio State University where his research focused on experimental psychology and biophysics. He studies and subsequent research at IBM occurred during an interesting time in computing history including the birth of computer-assisted instruction. He developed CAI courses on German, statistics and stenography.

Through it all, he contributed valuable knowledge to the intersection of psychology and computing.

After teaching at the University of Michigan for more than 20 years and three years of work with the Navy in Hawaii to research autonomous underwater vehicle system vision, he joined ASU in 1988. At ASU, he was the chair of the psychology department and later took his expertise to help engineering faculty. He studied visual systems as well as the neural and psychological foundations behind human interactions with computers.

Uttal worked with the industrial engineering department, which later became a part of the Fulton Schools, and he collaborated with prominent faculty including Regents’ Professor Doug Montgomery, Professor Ron Askin, Professor Dan Shunk, Professor Emeritus David Bedworth and Professor Emeritus Phil Wolfe. Uttal retired from ASU in 1999, earning a second emeritus professor status.

When Gerald Farin worked with colleagues to establish the Partnership for Research in Spatial Modeling center at ASU, he showed how design and the arts at ASU, as well as other disciplines, could benefit from geometric modeling.

Now more than two decades later, a new visualization and prototyping lab at the School of Art’s Grant Street Studios in downtown Phoenix will be dedicated in Farin’s memory.

“He was a trusted colleague and legendary teacher who guided a generation of students at ASU from 1987 until his death in 2016,” says Dan Collins, one of the founders of the PRISM lab and a professor of intermedia in the School of Art, part of the Herberger Institute of Design and the Arts.

The new Gerald Farin Lab for 3D Visualization and Prototyping promises to be a space where researchers, students and collaborators will benefit from its resources.

Thanks to a generous one-time grant from ASU President Michael Crow, the lab will have five systems — four 3D printers and one small computer numerical control router. Other equipment includes a new high-resolution, handheld 3D scanner as well as DIY-type body scanners.

In addition, local engineer Steve Graber is in the process of building a large-scale “deltabot”-type machine for the lab that will be capable of creating a printed object more than four feet tall.
CIDSE and the Fulton Schools host a variety of on-campus activities, after-school programs, summer camps and collaborations with faculty and engineering student organizations in an effort to engage Arizona’s K-12 students and create pathways that encourage them to become technically savvy, prepare for studies in science, technology, engineering and math fields and pursue careers in engineering. Through creative, hands-on activities, we hope to inspire these young students and show how engineering impacts our lives every day.

**Game Camp**

Game Camp is a unique, hands-on opportunity for middle and high school students to learn intensive video game creation, visualization and production. Campers use the latest software, hardware and development tools to create concepts and prototypes for 2D and 3D video gaming.

**App Camp**

App Camp teaches high school students the basics of iPhone app development. Participants learn the skills needed to create and develop smartphone apps. This year, the camp covered Apple XCode, Objective-C, Javascript, HTML5, user-interface design principles, mobile application design and development considerations, iPhone app construction, advanced debugging techniques, Web application development for portability and more.

**Robotics Camp**

ASU’s Robotics Camps are a summer program series designed for middle school and high school students who intend to pursue a science and engineering career.

Camp instructors use component-based robot construction, robotics programming, web programming and Alice game programming as a vehicle to teach the latest engineering design concepts and computing technologies. The robots built by students enter a robotics challenge and demonstration at the end of the camp.

**Ultimate Technology Boot Camp**

ASU’s Ultimate Technology Boot Camp is a completely residential camp where high school students experience life on the Polytechnic campus for 10 days. Campers learn how to create mobile apps, develop cutting-edge games, design and build robots and more from award-winning faculty and instructors. They work together in teams to learn design, development and content integration for software like games and apps.

**Adventures in Computing Camp**

Adventures in Computing Camp teaches beginners broad object-oriented programming concepts common to modern programming, then building on that foundation with an overview of Python. Campers start by learning how to create programs using Python; how to create easy-to-use graphical interfaces and how to draw pictures from code.
Above, beyond and always moving us forward, our staff contributions to the school are invaluable. Thank you for your efficiency, integrity and always getting things done.

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Ellie Ahmann</td>
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<td>Betsy Allen</td>
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<td>Amy Bennett</td>
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<td>Bulent Bicer</td>
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**Staff recognized at 2017 IMPACT awards lunch**

The Fulton Schools IMPACT awards recognize staff members who distinguish themselves through performance, innovative projects and exemplary teamwork.

**IMPACT nominees are:** Stephen Andrade, Robert Dent, Arzuhan Kavak and James White

**Fulton Difference recipient is:** Allison Curran

Allison Curran, manager of academic advising for CIDSE, received the Fulton Difference Award for her outstanding contributions as a leader in the Fulton Schools.