[atanasoff]
TODAY

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PIECING TOGETHER A PREMIER
**DATA SCIENCE
RESEARCH HUB**

SHE DREAMED IT
AND SHE'S DOING IT

AT HOME
WITH TECHNOLOGY

THE
**Dependable Data Driven
Discovery Institute**

2020

IOWA STATE UNIVERSITY
Department of Computer Science

2020

@ atanasoff
TODO

CONTENTS

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ATANASOFF TODAY

Cover photo: Members of D4; Pavan Aduri, Hridesh Rajan, Kevin Liu, Michael Cantanzaro, Chinmay Hegde, Daniel Nettleton, Vinodchandran Variyam, Namrata Vaswani, Li Wang, Eric Weber, Zhengyuan Zhu.

1969 50 **2019**
YEARS

IOWA STATE UNIVERSITY™
Department of Computer Science

"I'm very grateful that fate should have placed me at the beginning of this great adventure. I had great expectations, but none that matched present achievements, and none that could possibly match what we all expect of the future."

—John Vincent Atanasoff

MS '26 mathematics
Iowa State College
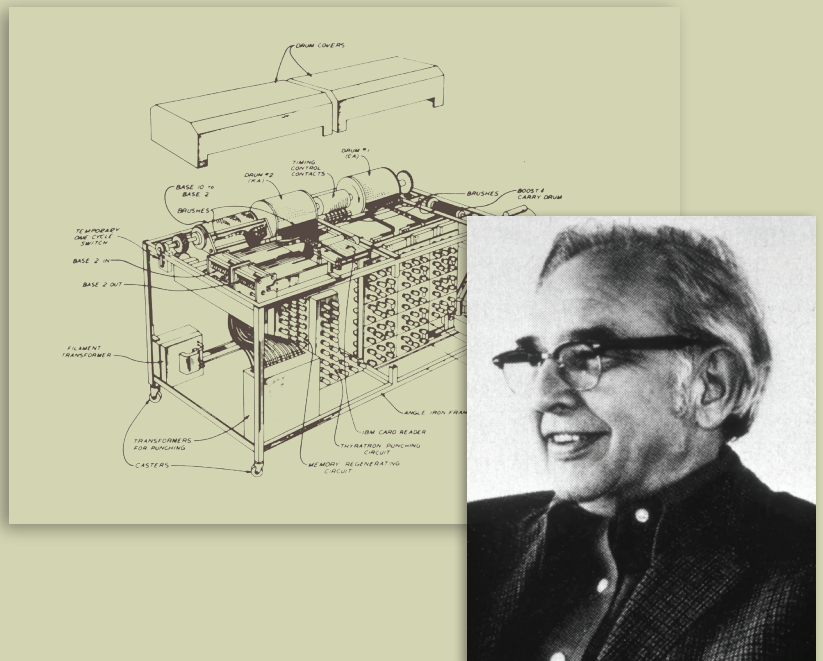
CELEBRATING THE PAST, INNOVATING THE FUTURE

As I write this letter, many of you are likely in temporary spaces as you do the best to continue moving your lives and work forward. By the time this magazine mails, you may even be transitioning into another new routine.

My routine has been in flux for quite some time. I began my role as Interim Chair in September last year. Since then, I've enjoyed digging in and learning more about the individuals who make it such a remarkable place. As the pandemic jilted us into an entirely new reality, I quickly learned how exceptional our faculty, staff and students truly are.

On March 10, President **Wendy Wintersteen** issued the official message to transition all university courses to an online format. Just a week later, almost all operations were moved off campus. Within just 13 days, all 54 courses taught by computer science faculty and graduate students were available to students in an online format. I am proud to report that our students successfully re-engaged in their classes, our instructors rose to the challenge of

reinventing their courses and staff have been truly incredible in their dedication and support of both students and faculty.

Innovation often springs from relentless challenges, and that's what I am seeing here. An interdisciplinary group of data science faculty responded to the global crisis by creating a single, indexable, searchable web-based database of over 60 years of coronavirus research. This infrastructure made important data quickly accessible to scientists, virologists, epidemiologists and public health officials working on medical solutions and critical planning. Faculty and staff went the extra mile for student success, from virtual communities to advisers who reached out continuously to offer students academic and well-being support.

We continue to conduct groundbreaking research, even from afar. In this issue you'll learn about a new collaboration, the **D4 (Dependable Data Driven Discovery) Institute**. It's an exciting initiative and an applicable model for innovative interdisciplinary work.

We are also investing in the expansion of artificial intelligence (AI) research, laying the groundwork for a new master's degree. As the world relies more and more on AI for scientific breakthroughs in healthcare, agriculture, energy, transportation, security and countless additional industries, the

need for graduates in this specialized area escalates. Our graduates will be highly sought-after, with their ability to apply AI and machine-learning methods to solve practical problems on a small to large scale.

You might recall that computer science faculty took a lead role in developing an interdisciplinary undergraduate degree in data science. It has been exciting to provide the administration and leadership for the major, minor and certificate. The program has enrolled more than 50 majors since its official start two years ago.

We are also pursuing growth in three additional priority areas: quantum information science, autonomy (both autonomous aerial vehicles and autonomous cars) and smart one precision health, a digital amalgamation of medical, environmental and genetic data to provide predictive and responsive health care.

Our existing strengths in theoretical foundations will provide ample opportunity to heighten our research profile in quantum information science. The recent strategic hiring of **Ali Jannesari**, **Nok Wongpiromsarn** and **Hongyang Gao** will fuel our emergence as a highly regarded home for not only autonomy, but also AI, machine learning and data science. Smart one precision health will encompass our unique breadth of faculty

research in bioinformatics, computational biology and medical informatics/smart home/gerontology.

Expanding our leadership in these innovative fields is ambitious, but so are our faculty, staff, students, alumni and friends. My vision for this growth entails a critical partnership between all of these stakeholders, and I am excited to ignite new relationships and spark existing ones on the path to reaching our goals. I invite you to share your ideas about how we can work toward endowed positions in support of these goals, or other high-need areas, like scholarships for underserved students.

I was delighted to meet several of our alumni and friends during our **50th anniversary celebration** in September 2019. Thank you for celebrating this milestone with us! I was truly humbled by the support from sponsors, the engagement of students and the incredible range of talent, knowledge and accomplishments of our alumni. I hope you will enjoy a recap and a few photos from the event in this issue.

Thank you for all of your kind words, your involvement in our students' academic adventures, your partnership and your continued support. We are truly a better department because of you.

Hridesh Rajan
Kingland Professor of Data Analytics and interim chair
Department of Computer Science

DEPARTMENT OF **COMPUTER SCIENCE**
C E L E B R A T E S
50TH **ANNIVERSARY**

1969 **50** 2019
YEARS

IOWA STATE UNIVERSITY™
Department of Computer Science

by **ROBYN GOLDY**

Last September, the Department of Computer Science marked 50 years of education and discovery at Iowa State University with a multi-day celebration on campus. More than 150 alumni, current students, past and current faculty, prospective students and supporters converged on campus for lectures, networking, tours and more.

"We have come a long way since our establishment in 1969. This would not have been possible without the extraordinary students during those years, now our distinguished alumni, who got excited by the promise of computer science as a discipline even when the definition and future of the discipline was unclear," said Hridesh Rajan, interim chair of the Department of Computer Science.

During the celebration's keynote lecture, "Our Digital Future (Through the Lens of the Past)," **Douglas Van Houweling** ('65 government), explored just how far

we've come from the days of punch cards and what innovations may be around the corner.

Guests also attended several timely and relevant lectures presented by esteemed department alumni and faculty. **Rajesh Parekh** (MS '93 computer science, Ph.D. '98 computer science), engineering director at Google, live streamed his lecture from Google headquarters. His talk focused on how large scale machine learning and computer vision algorithms can help to build a planet scale map.

Myra Cohen, Lanh & Oanh Nguyen Endowed Chair of Software Engineering and professor of computer science, demonstrated how programs are becoming biological, and how living programs behave in similar ways to traditional software.

Bamshad Mobasher ('85 computer science and mathematics, MS '89 computer science, Ph.D. '94 computer science), professor of computer science and the director

of the Center for Web Intelligence at DePaul University's College of Computing and Digital Media, shared innovative ideas on how providers of online information and services such as Amazon, Netflix and Spotify, can learn from context to enhance their personalized recommender systems.

Doina Caragea (Ph.D. '94 computer science) gave what would be a particularly prescient lecture in the time of COVID-19. Her talk, "Mining Social Media to Aid Disaster Response," demonstrated how machine learning solutions have the potential to transform the way in which crisis response organizations operate, and, in turn, provide better support to the victims of disasters in a timely fashion.

Other celebration events included a student alumni luncheon, campus and department tours, a graduate student poster competition and a breakfast where current computer science students had an opportunity to network

with individuals from more than 20 employer organizations. The celebration concluded on Friday evening with a banquet dinner at the ISU Alumni Center.

Alumnus and former department chair **George Strawn** ('69 mathematics) traveled from Virginia to attend the festivities. Strawn, a founding member of the department, said, "It has been a great privilege to have watched the department grow and mature over 50 years. I fully expect the next 50 computing years will be even more exciting than the last 50, and I equally expect ISU's Department of Computer Science will play a major role in those developments."

Clockwise from top left to center **1**. *Reception for the 50th Anniversary at the Alumni Center.* **2**. *Douglas Van Houweling delivers keynote lecture.* **3**. *Myra Cohen.* **4**. *Arthur Oldehoeft and Hridesh Rajan.* **5**. *Myra Cohen delivers a lecture.* **6**. *Student poster competition.* **7**. *Bamshad Mobasher.* **8**. *Wallapak Tavanapong speaks with students at luncheon.* **9**. *Doina Caragea.* **10**. *George Strawn and Douglas Van Houweling.* **11**. *Rajesh Parekh. photos by Alisha Carroll Keo Pierron Britney Walters-Chester*

Student **club 2.0**

While many spring events were canceled due to the pandemic, the Computer Science and Engineering Club 2020 made the most out of the academic year. New club leadership revamped the mission and meetings to help members and presenters get more out of their time together.

"This year we wanted to reinvent the club and truly set ourselves apart from other clubs," said **Austin Lowe** ('22 software engineering), the club's president. "Our club meetings felt very stale and there was nothing new brought to the table in a while. We worked hard to try new things and make each and every meeting a unique experience that would stick with each club member."

Their efforts paid off—the club received the Most Improved Organization Award from the College of Engineering's Engineering Week committee. The award was presented in February 2020.

Simanta Mitra, teaching professor of computer science and adviser for the club, said the club evolved quickly when they began acting on member input, added interactive presentations by speakers, and introduced new technology to communicate with current and prospective members.

contributed photograph

Steve Butler, associate professor and Barbara J. Janson Professor of Mathematics, addresses the newly-engaged Computer Science and Engineering Club at a monthly meeting.

Mitra said, "The current club officials, under the leadership of their president Austin Lowe, put in a lot of effort to make the club more inclusive and accessible – and fully deserved this award."

IOWA STUDENTS TACKLE ROBOTICS

Middle and high school students from Iowa schools learned about robotics through hands-on challenges.

contributed photograph

On Feb. 29, 2020, 25 middle and high school students had the opportunity to program robots during a **Science Bound** event hosted by **Yan-Bin Jia**, professor of computer science. Science Bound is an Iowa State University program designed to engage underrepresented Iowa students in agricultural and STEM exploration.

Students participating in the robotics event worked in groups to program Dash and Cue robots to achieve tasks using locomotion, sensing, obstacle avoidance and wall tracking. The experience was an overwhelming success, earning a student rating of 10 out of 10. The outreach event was a collaboration of graduate students **Matthew Gardner** and **Ling Tang**, Assistant Teaching Professor **Jinu Kabala** and undergraduate students **Aubrey Sijo-Gonzales** and **Healey Griffith**.

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Introducing LAS Connect - a free professional resource that allows you to offer and seek mentorship, connect with professionals with the same degree or industry and build and maintain a powerful network of fellow LAS Cyclones. Most exciting is this network's potential to connect alumni to current LAS students, who can use its mentoring feature to help them reach professional goals. These capabilities allow alumni to choose how they want to support and mentor current students — from simply giving career advice and reviewing resumes to conducting informational interviews and more! Sign up today via email, LinkedIn or Facebook at LASconnect.org.

Turing Award recipient **Martin E. Hellman** delivers **ROBERT STEWART DISTINGUISHED LECTURE**

Martin E. Hellman, professor emeritus of electrical engineering at Stanford University, presented the 2019 Robert Stewart Distinguished Lecture on Nov. 20, 2019, at Iowa State University. Hellman, a long-time advocate of transparency in science and national security, discussed the ethical considerations in disclosing technology development, especially in regards to the U.S. government. His lecture was titled, "The Technological Imperative for Ethical Evolution."

Hellman is credited with pioneering digital security,

and received a joint $1 million A.M. Turing Award from the Association of Computing Machinery with **Whit Diffie**, former vice president and chief security officer for Sun Microsystems, for the invention of public key cryptography. This technology is the foundation for conducting secure digital transactions and the development of tools to counter cybersecurity. Hellman is a member of the National Academy of Engineering and an inductee of the National Inventors Hall of Fame.

"The audience was clearly engaged with questions asked

Martin E. Hellman, professor emeritus of electrical engineering at Stanford University. contributed photograph

by undergraduate and graduate students, faculty and people outside of the ISU community," said **Yan-Bin Jia**, professor of computer science, who hosted Hellman.

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contributed photograph

Left to right: Gagan Chopra, Hridesh Rajan, Jeffry D. Sander.

Alumni presented with honors
Two alumni were honored at the 2019 College of Liberal Arts and Sciences Honors and Awards Ceremony on October 24, 2019, in Ames.

Gagan Chopra ('91 computer science, M.S. '93) was selected for the Computer Science Distinguished Alumni Award. Chopra, a group program manager and a member of the Technical Leadership Team in Microsoft's Search and Advertising division, has contributed extensively toward the expansion of Bing and Bing Ads from one product and one market to multiple product lines across the global market, with a revenue stream of more than $8 billion.

Jeffry D. Sander ('04 computer science, Ph.D. '08 bioinformatics and computational biology) was selected for the Genetics, Development, and Cell Biology Distinguished Alumni Award. Sander, a pioneering molecular and computational biologist at Corteva Agriscience, currently holds four patents and has been named among the world's most highly cited researchers by Clarivate Analytics (previously Thomson Reuters – World's Most Influential Scientific Minds) for each of the last three years.

Students make industry **connections**
The Computer Science Graduate Student Organization (CSGSO) helped facilitate connections between graduate students and industry partners during monthly club meetings. Representatives from different industries presented to the group, then enjoyed networking, food and

even some games with students. **IdRamp**, a decentralized identity technology company, co-hosted in October 2019; **Corteva Agriscience**, a global agricultural research and development corporation co-hosted in November; and **Kingland Systems**, a global data and technology firm founded by Iowa State alum **David Kingland** ('80

industrial administration) and his wife Deb, co-hosted the February meeting. The events were attended by up to 70 students.

Additional speakers like John Deere had to be canceled due to the pandemic, but students look forward to resuming these meetings as soon as possible.

< **STUDENT** FEATURE >

She **DREAMED IT** and she's **DOING IT**

by **PAULA VAN BROCKLIN**

contributed photograph

Armed with determination and confidence, junior computer science major Tracy Le is turning her dreams of a college education into reality.

[N]**ot much intimidates Tracy Le.** Her charismatic personality, vivacious laugh and broad smile exude confidence and determination. The junior computer science major from Altoona, Iowa, brought these traits with her to Iowa State University in the fall of 2018. And, like most freshmen about to embark on new adventures, Le experienced the typical first-year jitters. But those normal, anxious feelings were punctuated by the fact that Le was the first member of her immediate family to attend college.

"I was like a guinea pig because my parents didn't know what to expect, or what to do, or how campus life was," she said. "A lot of what they told me was cautionary–be safe, do your homework."

A brave new world

Armed with her spirited, can-do attitude, Le took a leap of faith and dove into her college career. But unlike other students, Le wasn't able to lean on her parents for guidance because these experiences were new for them, too.

"A lot of students can ask their parents, 'What are some crazy stories about being a student on campus?' They can get the low-down on what their parents did, or even advice about being a student on campus," Le said. "For me, my parents had never been on a university campus!"

Le knew if she was going to be successful at Iowa State, she needed to get involved with numerous clubs and organizations. After arriving on campus, she immediately became the social chair for Martin Hall and moved up to president her sophomore year. A naturally social person, Le also was the social chair for Freshmen Council. She joined numerous clubs, including the Computer Science and Engineering Club, Women in Science and Engineering (WiSE) and Digital Women. She also participated in the University Honors Program, where she worked in the computer language, Python, with Peng Wei, a former assistant professor of aerospace engineering, and his graduate assistant.

"Python was a language I wasn't super comfortable with but I wanted to push my boundaries as a student, and it involved interesting concepts like artificial intelligence, machine learning and search algorithms," she said. "As a freshman, I thought it was good to dip my hand in there and become exposed to it."

Called by computer science

Even as a young child, Le was fascinated by computers and technology. Around 8 years old, she recalls playing computer games on what would now be considered

an archaic desktop computer with an operating system encased in a tall tower.

"I remember playing with those games as a kid and thinking wouldn't it be so cool to figure out how this works and how to program games," Le said.

Her knack for computers and technology continued to progress into high school. When she was a sophomore, Le asked her uncle, James Pham, a software engineer at Workiva in Ames, if she could job shadow him. He agreed, and the experience heightened Le's interest in potential computer science and data technology careers.

"It was really cool. I liked the vibe," she said. "As I got closer to senior year of high school, I started taking some programming classes for fun, and I really enjoyed those courses."

Support network

Through it all, Le's uncle James, an Iowa State alum who earned a bachelor's degree in computer science in 2001 and dual graduate degrees in information assurance and computer engineering in 2007, encouraged her to pursue a college degree.

"He really pushed me to pursue college and a comp sci degree, but I was super hesitant—What if this is too hard for me? What if I'm not meant for this? He said, 'You won't know until you try,'" Le said.

Pham is confident that Le's strong work ethic and determination will help her succeed at whatever career she chooses.

"I think she has a lot of potential and will go wherever her heart desires," Pham said. "She can do anything as long as she's content doing it."

Others have confidence in Le's abilities, too. Her numerous academic awards include Iowa State's prestigious George Washington Carver Scholarship and the Kingland Data Analytics Scholarship. She also recently received the Maria B. Thompson "Innovation Maven" Scholarship for Women in Computer Science. Le is honored to be recognized for these academic achievements.

"It's flattering because it makes me feel like my hard work has paid off and I'm not just bumming around doing homework for no reason," she said. "It's just nice to have my hard work and achievements be recognized and noticed."

Paying it forward

In addition to her many campus activities, Le also finds time to tutor students in the Computer Science Help Room, something she finds extremely rewarding. She especially enjoys mentoring women in computer science and other STEM majors, who regularly seek her advice about classes.

"I always tell girls who come in for advice to just believe in yourself. If computer science isn't your thing, listen to your gut," Le said. "That's why I wanted to be in the tutor room. It's been great."

Liese Vanderbroek, a secretary in the computer science department, is Le's supervisor in the tutor room. She said Le initially reached out to her because she was interested in helping others succeed. Vanderbroek is pleased with Le's ability to assist students.

"She excels in the classroom, is reliable, dependable, conscientious and communicates effectively," Vanderbroek said. "Her enthusiasm and energy shine, whether she is participating as a team member or providing one-on-one mentoring to clients."

> "You don't need to get rewarded to do homework, but it justifies why I feel like I should be here. It's just nice to have my hard work and achievements be recognized and noticed."

Future plans

Le intends to complete her bachelor's degree in the spring of 2021, only three years after beginning her Iowa State adventure. This summer, she is interning as a software developer at Builder Trend, a construction software management company in Omaha, Nebraska.

Graduate school is a real possibility for her as well. She has also considered tackling cybersecurity crooks for the FBI or becoming a game developer, a nod to her childhood fondness for computer games.

"In addition to her passion, energy, and drive to succeed, Tracy is unexpectedly modest about her abilities," Vanderbroek said. "There are times when she surprises herself with her achievements. Those of us who know her are never surprised." @

< **ALUMNI** FEATURE >

AT HOME
WITH TECHNOLOGY

by **STACEY MAIFELD**

contributed photographs

[A]s a user experience researcher at Google Nest, Kofi Whitney spends a lot of time thinking about your home — everything from your thermostat to your morning routine. Now, with millions of people staying home as much as possible due to COVID-19, he is facing a strange reality for his research.

"We have to think about the validity of our results when people are at home all day," he said. "Some people aren't going to work. Maybe their budgets are different. There are many implications for how researchers work in this environment."

It's a good thing then that Whitney ('19 Ph.D. human computer interaction) is accustomed to unusual research environments, such as Iowa State's Virtual Reality Applications Center. Thanks to the Human Computer Interaction program and Department of Computer Science, that's where he developed the skills for his dream career in user experience research (UXR).

Thinking of you, the user

Whitney's parents introduced him to technology at an early age. He grew up playing in computer labs at South Carolina State University, where his dad was a professor, and using home gaming systems like Atari, Commodore 64 and the more obscure Vectrex system.

He built his first computers as a preteen, did web design for a local company in high school and graduated from Benedict College in Columbia, South Carolina, with his undergraduate degree in computer science.

"In college what became interesting to me is not just the engineering of the software, but also the design from a user's perspective," he said. "I remember at Iowa State we would say 'useful, useable and used.'"

When Whitney considered his options for graduate school, programs like Iowa State's interdisciplinary Human Computer Interaction (HCI) degree were quickly gaining momentum.

"It gave me an opportunity to have computer science as my home department at Iowa State, which was fabulous and the program faculty and staff were incredible in supporting me," he said. "The experience gave me a breadth of skills, but also allowed me to really go deep into research."

From science fiction to reality

At ISU's Virtual Reality Applications Center (VRAC), an interdisciplinary center that supports research across

Top left: Whitney's research group created a 3D replica of a real neighborhood near ISU's campus. Bottom left: Whitney's dad visits him at Google's headquarters for the first time. Top: Whitney's research group enjoys Christmas dinner hosted by Miller. Bottom: Whitney (center) and Miller (left) observe as a user virtually explores his childhood neighborhood.

campus, Whitney used virtual reality to study real-world research questions and methods.

"Virtual reality is a concept that's always fascinated me — getting the sense that you are somewhere else," Whitney said. "Over the years the biggest surprise for me has been how quickly it's gone from science fiction to reality. Virtual reality back then was not what it is today. You couldn't put on an affordable headset in the comfort of your home."

Through an interdisciplinary collaboration with Leslie Miller, professor emeritus of computer science, Sarah

Nusser, vice president for research, and Stephen Gilbert, associate director of the VRAC, Whitney helped replicate a research study — one involving census takers — in a virtual environment.

At the time, the U.S. Census Bureau wanted to switch from using paper printouts to mobile computers during its door-to-door outreach.

"My group wanted to understand what it meant to bring personal computers into a task that involves navigation, wayfinding and entering information," Whitney said.

In a traditional mobile computing study, researchers would follow participants into a real neighborhood and observe them while they completed a task using a mobile device. But mobile computing research in Iowa can be tricky, Whitney said. When people have to wear winter gloves to use devices or change up their walking pace in chilly temperatures, it can skew the data. Whitney's team traded those harsh realities of Iowa weather for virtual reality.

In the VRAC, participants had the sensation they were navigating a large-scale neighborhood while simultaneously viewing real-world objects, like a digital map on a mobile device.

"Very early on we were able to demonstrate a lab that enabled us to study a real-world task in a controlled lab environment; a task that would otherwise need to be studied in a field," Whitney said.

Cyclone connections

Today, long after completing his doctorate and moving to the San Francisco Bay Area, Whitney still meets weekly with Miller to discuss research.

"I had one of the best advisers in the world in Dr. Les Miller," Whitney said. "I still consider him to be my adviser and we talk often."

Miller said Whitney has all the critical qualities required to be a skilled and successful researcher, including empathy for users of new software and devices.

"Kofi is very intelligent, curious, determined to master new skills and has the desire and skill to understand existing literature before diving into a new topic," Miller said. "As a person, Kofi is a very special individual. He is kind, always willing to help anyone, loves to explain complex concepts to other students and is fun to be around."

Entering industry at Intel

Whitney's virtual reality research at Iowa State was the perfect preparation for one of his first industry jobs at Intel Corporation. He started in Intel's rotation engineer program and worked in virtual reality, wearable computing, gaming and smartphones, prior to joining its UXR group.

"The timing was incredible," he said. "Through the lens of Intel, we were seeing the beginning of the consumer VR push. I was able to do user research and ensure that Intel's customers would have awesome virtual reality experiences when that technology was launched. I got to work with world-class researchers, developers, business strategists and to really understand how a computing platform is foundational to these experiences."

> "I'm fortunate as a user researcher to be able to study groundbreaking technologies that are really fascinating and fun, and that require us to get creative about the techniques and methods that we use."

Virtual reality was made mainstream by the gaming and entertainment industries, but has unlimited potential for improving quality of life, Whitney said, from simulating a training with hazardous materials to demonstrating a medical procedure.

"What's amazing about virtual reality is that it can be used in environments that are comfortable and safe and sometimes even collaborative," he said. "This gives us the ability to do training and simulation for situations that wouldn't allow for that in the real world."

Not just a smart home, but a helpful one

At Google Nest, the technologies are all about the real world, with smart home products like thermostats and smoke and carbon monoxide alarms.

"This is another paradigm shifting set of products and technologies that change the way we live and work," said Whitney, whose research focuses on home energy management. "It's my job to understand people's needs and motivations through research. I work with designers, product managers and engineers to ensure Nest's

offerings are expressions of our desire to have not just a smart home, but a helpful one."

Whitney spends his work week planning, conducting, analyzing and reporting research. With your permission, he can even turn your living room into a field study site. On a typical field study day, he and his colleagues visit two to three homes, guiding participants through planned discussion topics and activities.

"Field studies are great because by situating study participants in their actual home environment, we are better able to invoke memories, experiences and values that are most important to people during our discussion and activities," he said.

Whitney said there is an art and science to identifying how technology can give users new "superpowers" at home. Early on, he might ask questions that inform how a smart home product should be designed or how it should function for its users.

"What are the moments of delight and inconvenience in your home throughout the day?" he said. "What are your day-to-day routines in and out of your home? What does comfort mean to you at home? What lulls you to sleep? What keeps you up at night?"

Once a product is further along in development or released to the market, a UXR asks more specific and tactical questions, like how happy you were with the installation process of your smart thermostat. Together, all of those questions help Whitney explore how smart home products can best solve problems in your home.

Fulfilling a dream

Whitney, who has always been interested in major technological shifts — from mobile computing to virtual reality to wearable technology — said that Iowa State helped prepare him for his dream job.

"I'm fortunate as a user researcher to be able to study groundbreaking technologies that are really fascinating and fun, and that require us to get creative about the techniques and methods that we use," he said. "For me, it's something that I've dreamed of since I was a kid. Iowa State, the Department of Computer Science, the Human Computer Interaction program, my adviser, and the faculty and staff were tremendous in preparing me for these opportunities and enabling me to develop so that I could fulfill a dream." @

< **FACULTY** FEATURE >

[T]he Dependable Data Driven Discovery Institute (D4) is a lot like a jigsaw puzzle that has taken four years to assemble. Hridesh Rajan, interim chair of the Department of Computer Science and Kingland Professor of Data Analytics, leads the effort by connecting experts in computer science, statistics, mathematics and engineering. Their unique blend of talent has built an innovative research hub for sharing data science expertise.

It's no surprise to Rajan that the pieces continue to fall into place for the D4 Institute.

"When accomplished researchers from multiple disciplines collaborate, you can create something special that is bigger than what each of you can do alone," Rajan said. "Teaming up allowed us to multiply our potential."

The core group includes: Pavan Aduri, professor of computer science; Chinmay Hegde, assistant professor of electrical and computer engineering; Daniel Nettleton, department chair and Distinguished Professor of Statistics; and Eric Weber, professor of mathematics. The project also involved Michael Cantanzaro, assistant professor of mathematics; Kevin Liu, assistant professor of computer science; Namrata Vaswani, professor of electrical and computer engineering; Vinodchandran Variyam, professor of computer science at University of Nebraska, Lincoln; Li Wang, associate professor of statistics and Zhengyuan Zhu, professor of statistics.

What began as an idea that Rajan sketched in a notebook has blossomed into a state-of-the-art clearinghouse for studying the data science pipeline. The group recently secured funding from the National Science Foundation and is laser focused on educating practitioners and data science experts about the ethical, legal, social and economic impacts of living in a data-driven society.

PIECING TOGETHER A
PREMIER DATA SCIENCE RESEARCH HUB

by **ANGIE HAGERTY**
illustrated by **KEO PIERRON**

Research that examines the 'data pipeline'

"Data permeates nearly every corner of our lives, and every day millions of data-driven decisions happen across the globe," Rajan said. "The D4 Institute will study the entire data science life cycle in order to improve the reliability of data-driven decisions that impact an untold number of people."

Rajan notes that it's no longer enough to focus solely on the accuracy of data or machine-learning algorithms. Studying the data science life cycle holistically is just as critical. These processes can profoundly impact whether or not data-driven discoveries and data-driven decisions are sound.

In a data-driven world, sound data science life cycles are imperative. Data-driven decisions can have profound and life-altering impacts on people's lives careers and futures—and even on whole societies.

"Whether a person is admitted into a college, approved for a mortgage—or serves a shorter or longer prison sentence—is determined today by a data science life cycle," Rajan said. "It's critical to fully examine the systems that gather, store and extract the knowledge and that's what we're doing at the D4 Institute.

"It's very important to broaden the scope and analyze the entire data pipeline to understand how data-driven decisions are made and if those systems are producing reliable, timely and trustworthy data," he said. "Our research attempts to expose and correct flaws in these systems."

The 'corner pieces' of the D4 Institute

When someone begins a puzzle, they usually lay out the corner pieces first. This jump-starts the process and begins the work of building out that initial foundation. The 2016 Midwest Big Data Summer School was one of the first 'corner pieces' from which the D4 Institute was built.

Rajan and Aduri were in uncharted waters when they agreed to organize the first Midwest Big Data Summer School, an intensive, week-long curriculum of workshops and lectures for students and early-career faculty who are interested in delving into data science research.

The program is geared toward a broad audience that extends beyond the computer science arena—from students studying sociology and economics, to faculty members from psychology, journalism and more.

"The first year, registration for the event filled in 24 hours and we had to secure a bigger venue," Rajan said. "This was a pleasant surprise, signaling a very real and significant interest in data science at Iowa State. Pavan Aduri and I were both worried and excited at the same time."

photographs by Keo Pierron
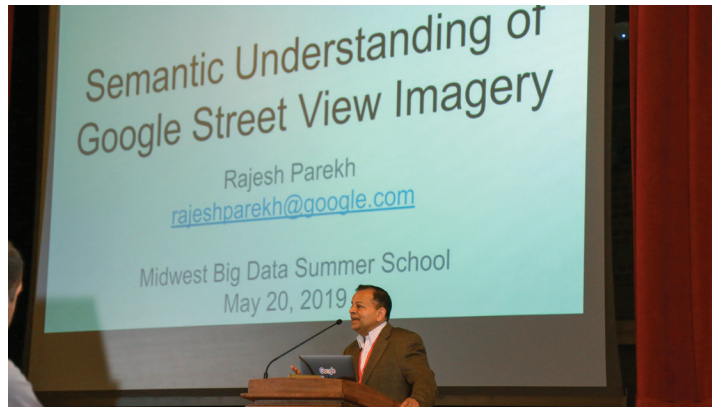
Top: Students at the MIdwest Big Data Summer School.
Bottom: Google's Engineering Director, Rajesh Parekh, (MS '93 computer science, Ph.D. '98 computer science), addresses a packed Gold Room in the Memorial Union.

The program's success led Rajan's group to lobby for the development of a data science program at Iowa State. They pointed to the overwhelming success of the first Midwest Big Data Summer School as evidence that a program would thrive on campus. Their voices were heard and the group assisted in the development of Iowa State's inaugural data science curriculum. Today, students from all academic corners of the university can earn a data science certificate, minor or major.

"We built on all of these initial successes. Then we quickly pivoted to research and other ambitious projects," said Pavan Aduri, professor of computer science. "Our group met regularly, rebranded as the Theoretical and Applied Data Science (TADS) Initiative and applied for NSF funding."

Their hard work paid off. In the fall of 2019, the team secured a $1.5 million NSF grant through the highly competitive TRIPODS (Transdisciplinary Research in Principles of Data Science) program. The funds seeded the development of the D4 Institute and will fund its research until 2022.

Tracy Kimbrel, program director at the NSF has high praise for the group's commitment to improving the data science life cycle.

"The D4 Institute at Iowa State brings a unique focus on all aspects of end-to-end dependability in data science to the program's portfolio," Kimbrel said. "This project has

> **"We want to train and grow the next generation of data science researchers. Our goal is to use the D4 Institute to establish Iowa State University as the epicenter of research on dependable data-driven discoveries."**

the potential to increase confidence and reduce risk in the data-driven decision-making that increasingly impacts the lives of our citizens on a daily basis."

Filling in essential pieces for students
Sumon Biswas ('21 computer science, Ph.D.) was immediately drawn to Iowa State's computer science program, in part because of Rajan's group. Research opportunities related to the data science field matched nicely with his career goals. Biswas was particularly drawn to the group's commitment to researching the data science pipeline.

"My research interests are very specific and tailored. My career focus blends software engineering, programming languages and data science," Biswas said. "The varied research opportunities at Iowa State, in particular with the D4 Institute, allowed me to become an entrepreneur of sorts and design my own career that fit with my goals."

Rajan has provided Biswas with a rich array of opportunities that have shaped his career path. In addition to engaging in cutting-edge research on the data science life cycle, Biswas provided significant contributions to the development of the successful TRIPODS NSF grant. He also attended the Midwest Big Data Summer School where he learned cutting-edge research methods that further drew him into studying the data science life cycle.

"It's been incredible," Biswas said. "I've learned novel research ideas from D4 researchers and practitioners who have introduced me to studying the data science pipeline and its properties."

Biswas is close to publishing his own research which he conducted at the D4 Institute.

"It's exciting to be involved in research that could improve software systems, which affect many people who are impacted by data-driven decisions," he said.

Rajan and his team plan to hire additional undergraduates, graduate students and postdocs at the D4 Institute. More students, like Biswas, will benefit from the experience of conducting NSF-funded research and working with seasoned experts who collaborate on studies.

Completing the D4 picture
Rajan and the team will continue to add capabilities and resources that allow the D4 Institute to expand its research efforts and gather additional data.

The pieces continue to come together for the D4 Institute as the group's longstanding members look to the future.

"We want to train and grow the next generation of data science researchers," Rajan said. "Our goal is to use the D4 Institute to establish Iowa State University as the epicenter of research on dependable data-driven discoveries."

Long-term goals for the D4 Institute include: Facilitating additional cross-disciplinary research, creating a hub for sharing data science expertise, educating data scientists, and spreading awareness about the importance of a fair and efficient data science pipeline that fosters honest and ethical decisions.

"In just a few years, we've expanded from a small team planning our first project into a successful NSF – funded research group that will be working hard to impact the study of the data science lifecycle," Rajan said. @

< ENTREPRENEURSHIP >

A class act

transforming software developers into entrepreneurs

by **ANGIE HAGERTY**

[T]**homas Swartwood moves to the front** of the classroom and distributes laminated cards to students working in teams. Each brightly colored card bears a single topic, such as "customers," "value proposition," "key resources" and "cost structure."

Swartwood, entrepreneurship fellow and associate professor of practice, directs six student teams to prioritize the words in order of importance.

"When you're starting a business, which of these is the most critical?" he asks.

Students shuffle and rearrange the cards as a cacophony of debate and discussion fills the room. Many agree. Some argue that channels aren't as important as relationships. Many question what "key resources" means or entails.

These aren't accounting or finance majors in a business class. They're all students, mostly seniors, studying computer science or data science. Swartwood was a guest lecturer in a Department of Computer Science class—CS 402c Senior Design.

"Cash is the most important. If you don't have money, you can't get your idea off the ground," shouts a student from her desk.

Swartwood dives in for a teachable moment. He begins educating these students about the art of converting ideas into businesses, careers or best-selling products.

"Entrepreneurship isn't about the coolest invention," he said. "It's about knowing what people want and delivering solutions that meet their needs."

After sharing how venture capital can flow to a solid business model, Swartwood concludes the exercise

by emphasizing the importance of validating the value proposition and building a model to bring it to customers.

"This unique collaboration in professor Simanta Mitra's class is a great example of what ISU offers its students," Swartwood said.

Leveraging technical expertise into marketable products

Taught by Simanta Mitra, teaching professor in the Department of Computer Science, the class is a

Top Left: Thomas Smartwood lectures about entrepreneurship in CS 402c Senior Design. Bottom left: Associate Teaching Professor Simanta Mitra helps a students with an assignment. Above: A team of students discuss entrepreneurs during a class exercise.

unique fusion of software development, creativity and entrepreneurialism. The goal is to inspire students to create a product which showcases the technical skills and knowledge that they've acquired at Iowa State.

Most of these students have finely tuned technical skills. They code for fun, develop software during Friday night hackfests and spend more time on GitHub than Twitter. However, their technical ideas often remain trapped in their laptops or simmering as sketches in a worn notebook.

"These students don't think about their ideas in terms of end users or customers because that's not their area of expertise," said Mitra. "This class exposes them to the business-development side of software development."

Startup incubator or classroom?

Imagine walking into a restaurant or a bar and wanting to hear your favorite songs. You launch an app on your phone that allows you to enter a shared room and add songs from Spotify to a cue that is updated in real time. By the time your drinks and appetizers arrive, the atmosphere is filled with your preferred tunes.

That's the simplicity and beauty of PartybAUX (pronounced party box), a web-based app that has evolved from proof-of-concept into a solid, marketable solution developed by a team of students enrolled in CS 402c. The group includes: Marcin Lukanus ('20 computer science), Dylan Mrzlak ('20 computer science), Alex Thompson ('20 data science) and Chris Pavlopoulos ('20 computer science).

"I thought of PartybAUX while walking to class and the group liked it. I've always wanted to someday create a business," Lukanus said. "Now we've got a somewhat tangible product."

During the semester, Swartwood and Mitra inspired the group to transform a light-bulb moment into a marketable product.

"This class has provided us with a new way of thinking," Pavlopoulos said. "We're not just coding. We've had the end user in mind throughout the entire process."

In February, Pavlopoulos had a job interview with Intuit. He discussed how the class sharpened his skills and introduced him to new ways of thinking about software development.

"During the interview, I mentioned that I had spent a great deal of time focusing on the user experience and thinking about the audience when I was developing software. One of the interviewers said, 'That is awesome. We don't really hear that too often from a software developer.'"

Pavlopoulos landed the job and began working for Intuit this summer.

> **"This class has provided us with a new way of thinking. We're not just coding. We've had the end user in mind throughout the entire process."**

A class as the ultimate start-up

The initial concept of infusing the art of entrepreneurialism into the science of software development, in a classroom setting, happened when Swartwood and Mitra struck up a conversation during a summer faculty picnic in 2019.

"I told Thomas about my software development class and he started talking about his efforts at the Pappajohn Center," Mitra said. "It just clicked. We knew we should work together."

With tremendous support from the Department of Computer Science, the class launched this spring.

"We are opening up new worlds for these students," Mitra said. "If they can start their careers understanding how other sides of the business work, then we have succeeded." @

< SCHOLARSHIPS, RETIRING FACULTY >

FAREWELL TO FACULTY

Les Miller, professor emeritus of computer science, recently retired after a lengthy career of innovative research, mentorship, teaching and service. Miller arrived at Iowa State University in 1984 as an assistant professor and progressed through the department to full tenure, even serving as chair. He earned grants and contracts from funders such as the National Science Foundation, the U.S. National Security Agency, John Deere and IBM. His work appears in publications such as the International Journal of Information and Computer Security and the Journal of Systems and Software. Miller still contributes to the field as a member or leader of organizations such as the International Society for Computers and their Applications and a member of both the European and National Academy of Sciences.

"In my early years at ISU, Les taught me as much as anyone about the ropes of academia, the stuff you don't learn in your coursework," said Jack Lutz, professor of computer science. "I served for years on the graduate committee, which he chaired, and he taught me - often via his inexhaustible store of anecdotes - the importance of grounding decisions in solid scholarly principles."

Also retired is **Shashi Gadia**, associate professor emeritus of computer science and faculty member since 1986. His research roots run deep in fundamental computer science, especially databases. His work has appeared in publications from around the world, such as Applied Computing and Informatics, International Journal of Computer Systems, Sciences and Engineering and the International Journal of Database Management Systems. His extensive service includes leadership roles in undergraduate studies, curriculum instruction and committees ranging from promotion and tenure to sustainability.

"I cherish the time spent with Professor Gadia to sort out many administrative issues together in the department during my tenure as the chair," said Carl Chang, professor of computer science. "He was always available to me with great patience. We shall miss a wonderful colleague and an outstanding academic advisor."

Do you have a fond memory about Professor Gadia or Miller?

> Share it on the department's Facebook page: **facebook.com/ISUComSci** and wish them well.

Research in the Department of Computer Science spans the fundamentals of computation through machine learning, robotics and other applied technologies. Our faculty, graduate students and even some undergraduate students are expanding the science of computing among interdisciplinary teams at Iowa State, and are collaborating with computer science leaders around the globe.

Some larger grants secured in the past year include:

> **HDR TRIPODS**: D4 (Dependable Data-Driven Discovery) Institute
Faculty: Hridesh Rajan (PI), Pavan Aduri (Co-PI), Chinmay Hegde (Co-PI), Daniel Nettleton (Co-PI), Eric Weber (Co-PI), Kevin Liu (Co-PI), Michael J. Catanzaro (Co-PI), Namrata Vaswani (Co-PI), Vinodchandran Variyam (Co-PI), Li Wang (Co-PI), and Zhengyuan Zhu (Co-PI)
Funding amount: $1,499,994
Funder: National Science Foundation, 2019 – 2023

> **Foundations of Software Testing Representations of Natural Processes**
Faculty: Myra Cohen (PI) and James Lathrop (Co-PI) **Funding: $499,961**
Funder: National Science Foundation, 2019 – 2022

> **Rapid Evolution of Influenza A Viruses in Swine Results in Zoonotic Viruses with Human Pandemic Potential**
Faculty: Oliver Eulenstein
Funding amount: $501,761
Funder: Department of Defense-Defense Advanced Research Projects Agency (DARPA), 2020 – 2021

> **Design for Dependability in Systems of Molecular Programs**
Faculty: Robyn Lutz (PI), James Lathrop (Co-PI), and Jack Lutz (Co-PI)
Funding amount: $800,000
Funder: National Science Foundation, 2019 – 2023

</ **SCHOLARSHIPS**, RETIRING FACULTY >

INVESTING IN STUDENTS

In an era of staggering student debt, donor support is critical to help students reach their academic goals. This year, undergraduate and graduate students received more than $20,000 in scholarships. The individual scholarship amounts vary, but the spirit of support is tantamount.

"Diversity of thought is instrumental to effective creative problem solving," said Maria Thompson ('82 computer science), who established the **Maria B. Thompson Innovation Maven Scholarship** in Computer Science – a fund designed to empower women in computer science.

"Women computer scientists are uniquely qualified to contribute their problem definition, problem reframing, and problem-solving skills to generate practical and feasible solutions for challenging and complex global problems. An investment in women computer science graduates is an investment in a better future for all of us."

Tracy Le, one of two 2019 recipients, said "Having the encouragement of someone means a lot to me, as it validates that I should continue on the path I am as a student and to not falter or lose hope when things may go wrong."

For **Benjamin Escobar** ('20 computer science) receiving the Mark Giese Computer Science Scholarship helped him pay it forward on campus. In addition to engaging in undergraduate research and high-impact internships, Escobar co-founded the Iowa State GNU/Linux Club and a second club centered around technical interviews.

"Receiving an independent donor's scholarship was extremely motivating as it was concrete recognition/ acknowledgment of extracurricular involvement," said Escobar. "Additionally, the donor enabled me to focus more on lateral growth and make college more than a place to simply 'get a job'."

Graduate students enrich the department as they pursue research with Iowa State's distinguished computer scientists. Thanks to scholarship funds, the department recruits high-caliber Masters and Ph.D. students.

Zahra Khoshmanesh, a two-time recipient of the Robert Stewart Early Research Recognition Award, is conducting research in software development. Utilizing various tools including machine learning algorithms to detect risky
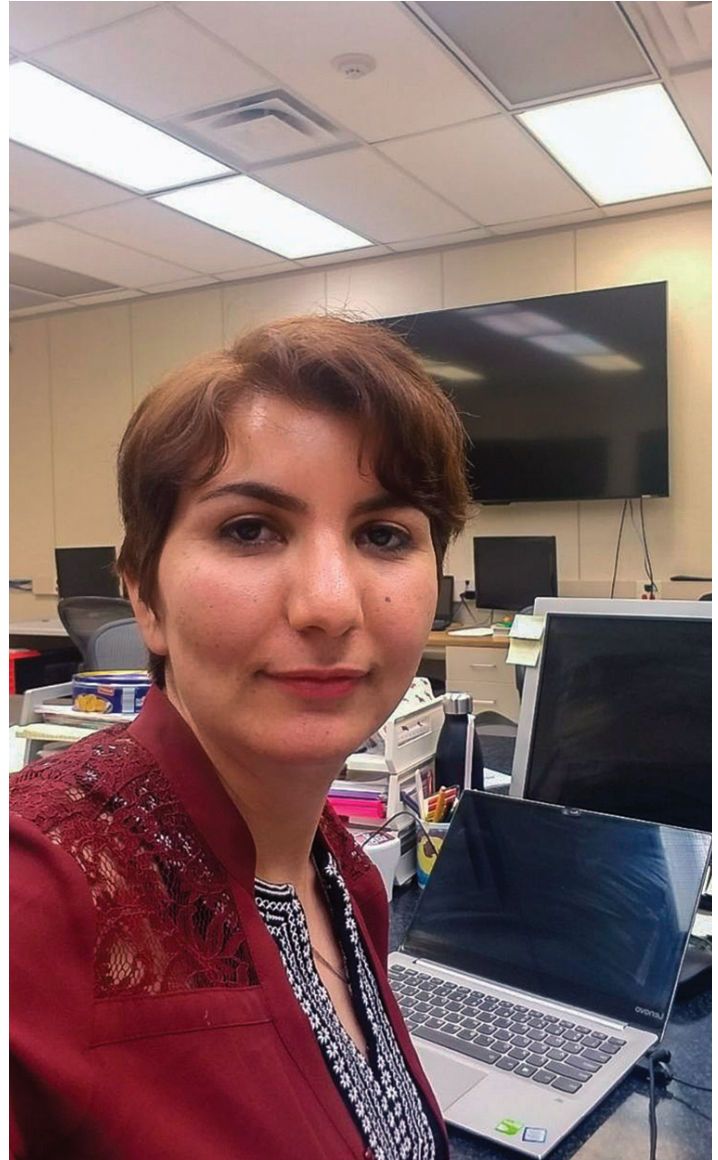
Zahra Khoshmanesh is a two-time recipient of the Robert Stewart Early Research Recognition Award. Contributed photograph

combinations of features, her research detects software issues early - critical work when applied to safety systems in airplanes, medical devices or autonomous cars.

"It does really matter for students who receive the scholarship, since the students feel great when their research is understood and appreciated by others in the university," said Khoshmanesh. "The scholarship encourages them to continue their education and stay in the research field."

Thank you to all of our incredible partners in helping our students thrive!

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