IMPACT

REPORT

FY20

BROADENING PARTICIPATION IN COMPUTING

ILLINOIS COMPUTER SCIENCE

EVERY CHALLENGE IS AN OPPORTUNITY

At the start of last year, no one could have imagined the coming challenges that the world would face. I am continually impressed with Illinois Computer Science's incredibly talented students, faculty, staff, and alumni, but no more so than now, after seeing our response to the COVID-19 pandemic. It's something that has been true of our community for as long as I can remember: the impossible is merely the next breakthrough in the making.

I am also proud of recent initiatives that Illinois CS has led to try to help make computing's remarkable possibilities available to everyone. You can find summaries about just a few of these Broadening Participation in Computing efforts on page 8. Among them, I am particularly excited about the launch of the Illinois Computing Accelerator for Non-specialists (iCAN), a new year-long certificate program that provides a pathway into CS for people from diverse backgrounds who already hold a bachelor's degree. It is just one of the ways that we are inspiring the next generation of innovation.

Nancy Amato

Nancy M. Amato (PhD CS '95)
Abel Bliss Professor
Department Head

This is the third edition of the Illinois Computer Science Impact Report. It is produced annually to showcase the innovations of our faculty and students and the accomplishments of our alumni, and to inspire our partners and peers in the field of computer science. Read more at: cs.illinois.edu/news.

Editorial Board/Writers: Colin Robertson, Aaron Seidlitz, Laura Schmitt, and Michelle Wellens
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GROUNDBREAKING RESEARCH

THIS REPORT HIGHLIGHTS THE INNOVATIONS OF OUR STUDENTS, FACULTY, AND ALUMNI, AND IT RECOGNIZES THEIR CONTRIBUTIONS TO THE FIELD OF COMPUTER SCIENCE. SEE HOW THE ILLINOIS COMPUTER SCIENCE COMMUNITY IS LEADING THE WAY.

HOW SMART ARE THOSE SMART DEVICES, ANYWAY?

Amazon Echo, Nest Thermostat, Ring Doorbell, Philips Hue Lighting, iRobot Roomba, plus televisions, locks, appliances, and even beds—the use of smart devices has exploded in the last few years. With it comes the promise of automation and control with a voice command or by tapping a smart phone's button. But thanks to a $10 million NSF grant, Illinois CS professors and cybersecurity researchers **Carl Gunter** and **Adam Bates** are part of an interdisciplinary team seeking holistic answers to certain questions. For example, what does the lifecycle of these household Internet-of-Things (IoT) devices look like? What do all of these "smart things" in the home mean for users' privacy and security?

From top: Adam Bates, Carl Gunter

UNDERSTANDING FUTURE EVENTS

Using artificial intelligence to predict future events still seems a bit like something from science fiction. But that's one of the goals of the Defense Advanced Research Project Agency's (DARPA's) Knowledge-directed Artificial Intelligence Reasoning Over Schemas (KAIROS) program, which has awarded $12.3 million over four years to a team of researchers led by professor **Heng Ji.** The team's project, named RESIN—Reasoning about Event Schemas for Induction of kNowledge, seeks to create a framework for the next generation of event understanding systems, with an ambitious goal: being able to provide a comprehensive understanding of evolving situations, events, and trends.


ADVANCED AUTOPILOT TO MIMIC THE "SULLY FACTOR"

A team of interdisciplinary researchers, including Donald B. Gillies Chair in Computer Science **Lui R. Sha,** is working on an advanced autopilot that will autonomously evaluate
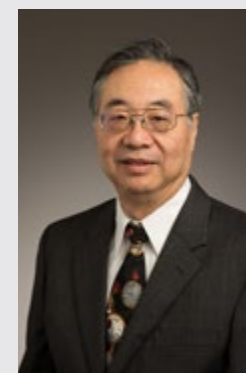
unforeseen circumstances, take the best course of action, and land a plane safely. Their inspiration for how the system should perform? The "Miracle on the Hudson," where experienced pilot Chesley "Sully" Sullenberger quickly reacted to land an airplane safely after losing two engines shortly after takeoff.

VISUALIZATION TOOL GOES VIRAL
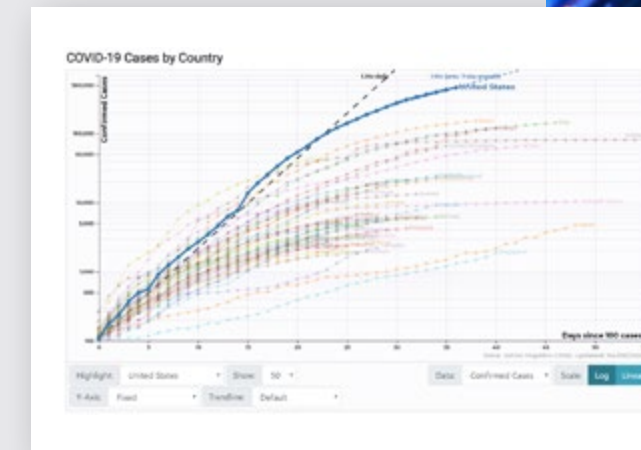
Professor **Wade Fagen-Ulmschneider** created 91-DIVOC, an interactive data visualization that depicts the exponential spread of COVID-19. Since this tool was originally published on March 19, the 91-DIVOC visualization has gone viral, including being used in briefings by the governors of Kentucky and Washington state. It was named by *The Verge* as one of the six best illustrations of COVID-19 data, and was described by *Popular Mechanics* as the "easiest way to make sense of essential data."

Explore the visualization at **91-divoc.com**.

GROUNDBREAKING RESEARCH

C3.AI DIGITAL TRANSFORMATION INSTITUTE LAUNCHES, SUPPORTS THREE ILLINOIS CS PROJECTS TO MITIGATE COVID-19

A new research consortium chaired by **Thomas M. Siebel (BA History '75, MBA '83, MS CS '85)** will spend $367 million in its initial five years to accelerate innovation in artificial intelligence. One of the initial goals for the C3.ai Digital Transformation Institute (DTI) is to mitigate COVID-19 and to address risks from future pandemics. "We have the opportunity through public-private partnership to change the course of a global pandemic," said Siebel.

C3.ai Digital Transformation Institute

Professor **Tandy Warnow** is co-chief scientist for the institute, which awarded $5.4 million to 26 projects in June. Three COVID-19 related projects led by Illinois CS faculty received funding. Professors **Sanmi Koyejo** and **Dakshita Khurana** want to enable medical institutions to collaboratively train accurate models in order to improve decision support systems, while still respecting privacy regulations. "Our work is hoping to improve some of the tools at decision-makers' fingertips to help them now, and, perhaps even more importantly, down the road," said Koyejo.

Thomas M. Siebel

Sanmi Koyejo
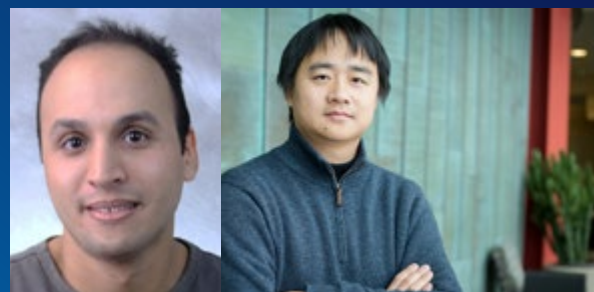
Dakshita Khurana

Mohammed El-Kebir

Jian Peng

"Do (the strains) behave differently in different organs? When spread happens, do they compete against each other? Or are they co-transmitted?"

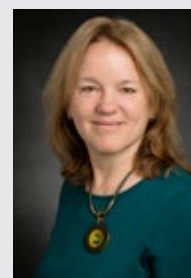## ASKING NEW QUESTIONS AFTER FINDING MULTIPLE SARS-COV-2 STRAINS

Illinois CS researchers, including professors **Mohammed El-Kebir** and **Jian Peng,** co-principal investigators on an NSF RAPID grant, used genomic signature deconvolution to identify multiple SARS-CoV-2 strains present in the global population, and they found evidence of the coexistence of distinct strains within infected patients. El-Kebir hoped this finding would open the medical community up to new questions: "Do (the strains) behave differently in different organs? When spread happens, do they compete against each other? Or are they co-transmitted?"
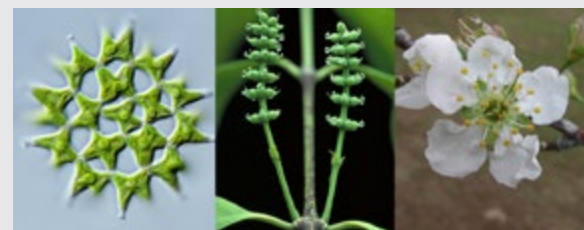
ADVANCED ALGORITHMS HELP CONSTRUCT GROUNDBREAKING EVOLUTIONARY TREE OF GREEN PLANTS

Founder Professor of Engineering **Tandy Warnow** and her former student Siavash Mirarab developed the ASTRAL-II algorithmic method to help an international consortium of scientists construct a large evolutionary tree of green plants. The scientists released gene sequences for more than 1,100 plant species—the culmination of a nine-year research project known as the One Thousand Plant Transcriptomes Initiative—in *Nature* in October 2019. The team's findings examined the diversification of plant species, genes and genomes across the more than one-billion-year history of green plants dating back to the ancestors of flowering plants and green algae. ASTRAL-II is now one of the leading methods for species tree estimation world-wide.

Photo: Green alga Lacunastrum gracillimum, female cones of gymnosperm, Gnetum gnemon, and cherry tree flower, Prunus domestica. Photo credits: Michael Melkonian and Walter S. Judd.

FIRST-OF-ITS-KIND ANALYTICAL PLATFORM TO IMPACT GENOMIC RESEARCH

A multidisciplinary team of researchers led by professor **Saurabh Sinha** unveiled the Knowledge Engine for Genomics (KnowEnG), a free-to-use, cloud-based analytical platform that guides researchers through the process of interpreting complex genomic datasets. The platform includes tools for popular bioinformatics tasks such as gene prioritization, sample clustering, gene set analysis, and expression signature analysis; it is expected to expedite biomedical discovery. The project was supported by an initial five-year grant from the National Institutes of Health as a Center of Excellence in Big Data Computing. Thanks to additional support from the Cancer Center at Illinois and NCSA, the system can accommodate new forms of data, new analytical processes, and new visualization strategies over time.

ADVE EARNS AN HONOR UNLIKE HER OTHERS

Sarita Adve, the Richard T. Cheng Professor in Computer Science, was elected as a 2020 member of the prestigious American Academy of Arts and Sciences. Even as her career accolades have become quite extensive, Adve called this the most selective honor she's received. Established in 1780, the history of the Academy is rich, but new possibilities are the most important to Adve. "This definitely gives me a platform to further my efforts in making change," she said. "Being a member of the Academy broadens my exposure to a diverse set of views from some incredibly talented people and amplifies my own message with additional credibility."

100+ WORLD-CLASS FACULTY

DEPTH & BREADTH
FACULTY BY RESEARCH AREA
(Counts recognize faculty doing research across multiple areas.)

Research Area	Count
Architecture, Compilers, and Parallel Computing	15
Artificial Intelligence	22
Bioinformatics and Computational Biology	10
Computers and Education	17
Data and Information Systems	9
Interactive Computing	10
Programming Languages, Formal Methods, and Software Engineering	16
Scientific Computing	9
Security and Privacy	16
Systems and Networking	16
Theory and Algorithms	16

16,227 Degrees CONFERRED TO 14,905 ALUMNI

BS 9,914	MS 4,842	PhD 1,475

17 ACM Fellows

17 IEEE Fellows

#5 Computer Science Graduate Ranking, *U.S. News & World Report*

40 NSF CAREER Awards

18 Endowed Chairs and Professorships

9 Sloan Research Fellows

MORE NSF FUNDING
Illinois was awarded more NSF Funding than any other University in **7 of the last 10 years**

ENDOWMENT
$20 MILLION*

$786,000 INCOME
Funds student awards, scholarships, and fellowships; faculty chairs and professorships; lectureships; research; and general operations.
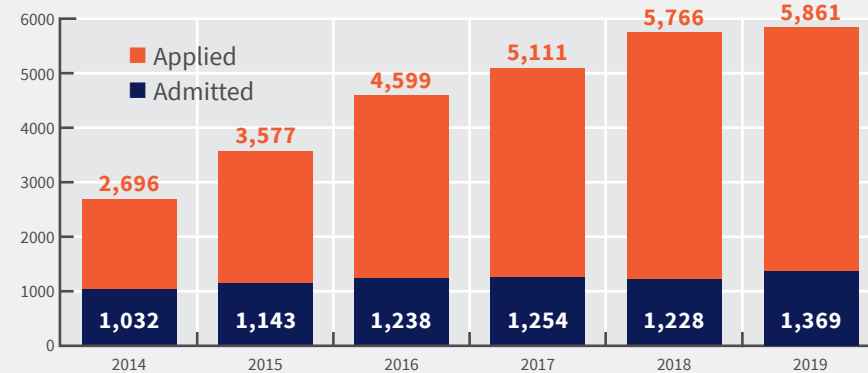
*Market value.

NEW GIFTS & COMMITMENTS
$5 MILLION

$1.7 MILLION in New Current Use Gifts and Commitments

$3.4 MILLION in New Endowment Gifts and Commitments

UNPRECEDENTED UNDERGRADUATE DEMAND, TALENT, & DIVERSITY

Applied / Admitted

Year	Applied	Admitted
2014	2,696	1,032
2015	3,577	1,143
2016	4,599	1,238
2017	5,111	1,254
2018	5,766	1,228
2019	5,861	1,369

35 STATES, **35** COUNTRIES REPRESENTED

33.7 INCOMING ACT (COMPOSITE AVERAGE)

69.1% MALE / **30.9%** FEMALE (ENROLLED FRESHMEN, FALL 2019)

Average Starting Salaries for Illinois CS Graduates who Graduated during 2018-2019
BS: $106,551   MS: $123,106   PhD: $151,300

SPRING 2020 FEMALE ENROLLMENT

27.1% Undergraduate Female Enrollment

19.8% Graduate Female Enrollment

STATE OF ILLINOIS SUPPORT – FY19
$18.1 MILLION

RESEARCH EXPENDITURES – FY19
$31.8 MILLION

SPRING 2020 ENROLLMENTS

UNDERGRADUATE

Program	Count
Computer Science	958
Mathematics & Computer Science	271
Statistics & Computer Science	313
CS + Advertising	13
CS + Anthropology	25
CS + Astronomy	39
CS + Chemistry	30
CS + Crop Sciences	11
CS + Economics	34
CS + Geography and GIS	6
CS + Linguistics	80
CS + Music	14
CS + Philosophy	14
Total Undergraduate Enrollment	1,808

GRADUATE

Program	Count
Master of Computer Science (MCS)	87
Online MCS / MCS in Data Science	986
Master's	105
Master's in Bioinformatics	7
PhD	368
Total Graduate Enrollment	1,563

IMPROVING EXAM EXPERIENCE FOR STUDENTS, FACULTY AND COURSE STAFF

The Computer Based Testing Facility (CBTF), which uses web-based learning management systems to deliver exams in a convenient, proctored environment, celebrated its five-year anniversary in the fall of 2019. Its services are especially useful to students with learning-related disabilities and large-enrollment lecture classes that don't have ideal classroom space to give exams. Co-founded by professor **Craig Zilles,** CBTF typically proctors more than 50,000 exams for about 6,000 unique students in 25–30 classes each semester.

Above: CBTF founders, Craig Zilles, far left, Matthew West, foreground center, and David Mussulman, back row second from left, join administrative team members, Carleen Sacris and Patrick Bailey, far right.

ILLINOIS PIONEERS NEW CS + ANIMAL SCIENCES DEGREE

The new CS + Animal Sciences degree, first of its kind in the country, expands the number of blended CS + X degrees pioneered by Illinois CS to 11, joining CS + Crop Sciences as the second such degree to be offered in the College of Agricultural, Consumer, and Environmental Sciences. CS + X, which offers a strong foundation in computer science with training in the arts or sciences, was featured in *U.S. News & World Report's* "Best Colleges of 2020" guidebook.

ADVE CO-LEADS NEW CENTER FOR DIGITAL AGRICULTURE

A new center at Illinois brings together agricultural producers, researchers, and industries to innovate on the technology that is transforming agriculture to feed and support a growing global population. The Center for Digital Agriculture, which is a collaboration between The Grainger College of Engineering, the College of Agricultural, Consumer and Environmental Sciences, National Center for Supercomputing Applications, and the Carl R. Woese Institute for Genomic Biology, seeks to develop digital solutions to agricultural roadblocks. Co-directed by **Vikram Adve,** the Donald B. Gillies Professor in Computer Science, the Center's faculty and staff are working closely with the colleges to design a new master's degree in Digital Agriculture.

Jeffrey Forbes (left), the Director of the Broadening Participation in Computing Alliance Program at the National Science Foundation, speaks with workshop participants.

"Increased participation in computing is crucial for continued leadership in research and innovation, and it is necessary to provide access to the opportunities in this exciting field to all."
– Department Head Nancy M. Amato

iCAN
READY TO OPEN NEW POSSIBILITIES

Tiffani Williams

The Illinois Computing Accelerator for Non-specialists (iCAN) – a new one-year certificate program focused on broadening participation in computing – is designed for students who have a bachelor's degree in any field other than computer science. **Tiffani Williams,** who joined the Illinois CS faculty as Teaching Professor and Director of Onramp Programs, worked with new Assistant Teaching Professor **Yael Gertner** to develop the iCAN curriculum. It will support students from diverse backgrounds and ways of thinking. "Someone who enjoys solving problems, creating innovative solutions, and who is looking for a pathway to a satisfying tech career in industry or research would be a great candidate," Williams said.

Learn more at **cs.illinois.edu/ican**.

FIRST-EVER WORKSHOP ON DEPARTMENTAL PLANS FOR BPC

In an effort to support expanded access to computing, Illinois CS hosted the first-ever workshop on Departmental Plans for Broadening Participation in Computing (BPC). Eighty-six leaders from 31 computing institutions across the U.S. were invited to Urbana for the NSF-sponsored workshop, which was designed to help departments outline plans for activities, goals, and metrics to provide more inclusive environments. The NSF Directorate for Computer and Information Science and Engineering is planning to phase in a requirement for Principal Investigators to include meaningful BPC plans for all of its research programs. "Increased participation in computing is crucial for continued leadership in research and innovation, and it is necessary to provide access to the opportunities in this exciting field to all," said Department Head **Nancy M. Amato,** one of the workshop's organizers.

ILLINOIS HOSTS RECORD NUMBER OF RISING STARS

The University of Illinois at Urbana-Champaign welcomed 90 promising early-career women in electrical engineering, computer engineering, and computer science to campus for Rising Stars in EECS, an intensive workshop for graduate students and postdocs who are interested in pursuing academic careers. Department Head **Nancy M. Amato** and AMD Jerry Sanders Chair of Electrical and Computer Engineering **Wen-mei Hwu** co-chaired the workshop, which provided a series of panels, discussions, and resources aimed at providing advice and networking opportunities as participants prepared for the job search. "With the Rising Stars Career Center, we really wanted to try to allow participants to personalize their workshop experience to best meet their professional and career needs," said Amato.

BRINGING THE FIELD TOGETHER

INDUSTRY / FACULTY / STUDENTS / ALUMNI

Lecture Series Gift Reflects Banerjee's Pursuit of New Ideas

When **Utpal Banerjee (MS CS '76, PhD CS '79)** died in 2017, members of his family said they were only beginning to understand the impact the Illinois CS alumnus had on high performance computing. Using a gift to ensure his memory and legacy live on at Illinois, Banerjee's daughter – **Sanchita Banerjee Saxena** – agreed to establish the Utpal Banerjee Distinguished Lecture Series in High Performance Computing. "My dad always wanted to engage with new ideas that were coming up, he always loved interacting with both junior and senior scholars and taking part in interesting conversations," said Saxena.

Innovation, Perseverance Lead to Cleetus' Success

Illinois CS undergraduate student **Ananya Cleetus** understands what the struggle with mental health is like. Rather than allowing it to define her, she used it to create an app called Anemone. With the app, users can create a crisis plan, which provides information including warning signs, coping methods, medications and emergency contacts in the event of a mental health crisis. "I realized that a good idea is a good idea, no matter what your background is, where you're from, or what your focus is," Cleetus said. Its effectiveness earned her the Fiddler Innovation Fellowship, a $10,000 scholarship.

CORPORATE CONNECTION

CS-ECE industry affiliates program

Illinois CS and Illinois ECE sponsor **Corporate Connection,** a comprehensive program to help industry connect with faculty and students who are at the forefront of computing. And **Startup Corporate Connection** is just for startups - part of our vibrant ecosystem for innovators and entrepreneurs

32 **CORPORATE AFFILIATES**

STARTUP AFFILIATES **25**

66 **CORPORATE EVENTS**

Networking Startup Veriflow Acquired by VMware

Illinois CS startup Veriflow, a network vulnerability and outage prevention company, was acquired by VMware in August 2019. VMware is integrating Veriflow technology into its vRealize Network Insight product to enhance its network visibility and analytics capabilities. Veriflow was founded by CS alumnus **Ahmed Khurshid (PhD CS '15)** and faculty **Matthew Caesar** and **Brighten Godfrey** in 2013 as the first networking company to apply formal verification to network infrastructure, mathematically assuring that an organization's network is operating with the intended availability and security. The core technology was originally developed at Illinois as part of Khurshid's PhD dissertation.

Left to Right: Ahmed Khurshid, Matthew Caesar, Brighten Godfrey

BAAC STUDENT CLUB WINS STATE FARM GRANT

Representatives from State Farm presented the Blacks and African Americans in Computing (BAAC) student club with a $5,500 check from the State Farm Foundation, after the group's grant proposal was accepted by the Good Neighbor Citizenship® Company Grant program. BAAC is eager to use the funds to expand their outreach and community building efforts in the spirit of the group's mission, which is to become a strong support system for minorities in computing-related fields that fosters scholarship, professional development, and a sense of community. "Our members are looking forward to working with State Farm to build a future for underrepresented computing students in our club and in our community," said **Joseph Sieger,** BAAC president and co-founder.

Clarence Ellis

Representatives from J.P. Morgan Chase presented the J.P. Morgan Chase WCS Scholarship to Mihika Aggarwal (middle) at the Fall 2019 Celebration of Excellence.

CELEBRATING EXCELLENCE

Over 150 of the department's amazing students and faculty were recognized during the 2019-2020 academic year with awards, scholarships, or fellowships. Many of these recognitions provide financial support thanks to generous donations from friends and alumni. Thank you for your support!

Donor Shig Matsushita (MS EE '63, left) helped Department Head Nancy M. Amato (right) present the Saburo Muroga Endowed Fellowship to Felipe Arias at the Fall 2019 Celebration of Excellence.

DISTINGUISHED ALUMNI

Illinois Computer Science recognizes the accomplishments and impact of its faculty and alumni every year, like professor **Clarence Ellis,** who was honored with our Distinguished Achievement Memorial Award in 2019. Ellis, who died in 2014, was the first African American to earn a PhD in computer science (PhD CS '69). He did pioneering research in operational transformation, groupware, and computer-supported cooperative work, holding multiple positions in industry before joining the faculty at the University of Colorado at Boulder in 1992. Ellis was named an ACM Fellow in 1998.

In 2019, we also honored **Vinay Hiremath** for early Career Achievement; **Jeff Holden** for Distinguished Achievement; **Hui Fang** and **Ali Farhadi** for early Academic Achievement; **Sy-Yen Kuo** and R**aymond Mooney** for Distinguished Academic Achievement; **Shig Matsushita** for Distinguished Service; **Unnat Jain** and **Shadi Abdollahian Noghabi** with David J. Kuck Outstanding Thesis Awards; **Wade Fagen-Ulmschneider** with the Scott H. Fisher Computer Science Teaching Award; and **Jian Peng** with the C.W. Gear Outstanding Junior Faculty Award. *To learn of their accomplishments, visit cs.illinois.edu/about/awards/alumni-awards*.