ILLINOIS COMPUTER SCIENCE

IMPACT REPORT

FY19

LEADERSHIP IN THE FIELD

BUILDING ON OUR STRENGTHS TO IMAGINE THE FUTURE

Computer science touches virtually every aspect of our lives – food, health and wellness, transportation, the economy, education, communication, entertainment, and more – and that influence is only growing. Through our commitment to groundbreaking research and education, Illinois Computer Science has long been at the leading edge of CS's influence on the world.

On the pages that follow, you can see a path forward, building on our strength in the realms of security, computer vision, architecture, and data, to name just a few. We intend to grow our presence in robotics in conjunction with new and ongoing work in digital agriculture and autonomy. Illinois CS also plans to continue to open doors to those looking for a way into the field, inspiring the next generation of innovation.

As you read through the rest of this report, I hope you share in the pride I take from the accomplishments of our talented faculty, staff, students, and alumni.

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

This is the second 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: *David Mercer, Colin Robertson, and Michelle Wellens*
Contact us: *communications@cs.illinois.edu*

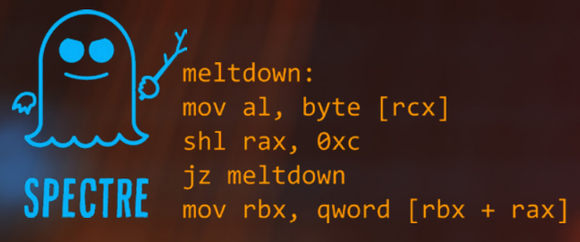
ILLINOIS COMPUTER SCIENCE

LEADERSHIP IN THE FIELD

FUNAI ACHIEVEMENT AWARD FOR PIONEERING WORK IN DATA MINING

Prof. Jiawei Han was recognized with Japan's highest honor for information science due to his pioneering work in data mining and his impact on information network analysis, database systems, and data warehousing. Han, who is one of the most-cited researchers in computer science, was among data mining's founding researchers. "I was thinking, 'In the future, the database must be integrated with artificial intelligence... If you really want to make good use of the data, you have to somehow make the data intelligent."

LEADING A NEW DEFENSE AGAINST SPECTRE, MELTDOWN ATTACKS



A security flaw that's built into processors has opened the door to Spectre and Meltdown: two exploits that enable data theft. But **Profs. Josep Torrellas, Darko Marinov, and Christopher Fletcher** are leading work on a permanent solution, named InvisiSpec, that holds enough promise that it's being backed by $1.5 million from **Intel.** InvisiSpec hides speculative execution, the vulnerable process that's also a key to fast computations, from malicious software.

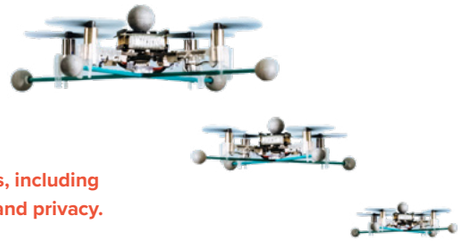
PREVENTING THE SPREAD OF MISINFORMATION ONLINE

Over the past few years, social media bot accounts have made news for their suspected influence over elections, healthcare decisions, and a number of other aspects of life. But picking them out of a crowded news feed can be a challenge. **Prof. Tarek Abdelzaher** and his students are working on a unique way to detect bots by comparing large numbers of social media accounts and looking for patterns. "You realize, gee, for some reason the groups of accounts tweet exactly the same things at exactly the same time. The odds of humans being so in sync that they tweet the exact same thing at the exact same time is impossible," Abdelzaher said.

DATA DRIVEN RESEARCH BRINGS BUBBLE TEA TO THE EMOJI TABLE

On Facebook Messenger alone, more than 5 billion emojis are used every day to communicate ideas quickly and visually. The possibilities for emoji-based communication have prompted **Prof. Ranjitha Kumar's Data Driven Design Group** to examine the information that emojis can convey, with the help of **Opico,** the lab's emoji-based review app. Their data showed gaps in the lexicon, prompting the team to propose a new emoji zero-width joiner for bubble tea: a combination of three existing emojis that is expected to be released in 2020.

RESEARCH LEADERS

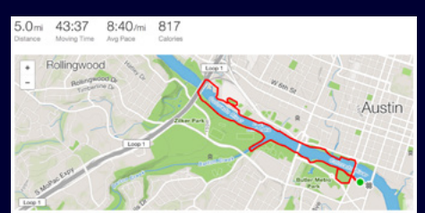


Trailblazing researchers make Illinois CS a leader in a number of fields, including architecture, computational geometry, computer vision, and security and privacy.

SECURITY & PRIVACY

YOU CAN RUN, BUT CAN YOU HIDE?

If you use a mobile app to track your distance and route, that walk, run, or ride may be giving away your home address, even if the app lets you obscure your exact starting and end points within blurred circles. Applying a little geometry, **Prof. Adam Bates** and his students figured out that the starting and end points are at the center of the blurred circles, pinpointing the homes of active users at 95% accuracy. Their work allowed app makers such as **Strava** and **Garmin** to modify their service to protect users.



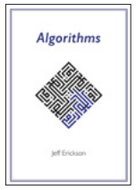
Strava run and cycling tracker app.

MONITORING THE BEHAVIOR OF DRONE SWARMS USING MACHINE LEARNING

Drone and ground-rover swarms have a wide range of potential uses in defense, search-and-rescue, disaster recovery, agriculture, and elsewhere. But they are vulnerable to attacks because they rely on wireless communication. **Prof. Sibin Mohan** is working with Boeing to establish baselines for normal drone and ground-rover group behavior, using machine learning techniques. “If we can detect that the system, or parts of a system, is not functioning correctly, then we can fix it,” Mohan said.

HASSAN'S NODOZE INTRODUCES TRIAGE TO SECURITY

A security team for a large organization will see thousands of threat alerts a week, far more than can effectively be handled. PhD student **Wajih Ul Hassan** has found a way to cut that load down to a manageable fraction. Working with **NEC Laboratories** and using funding from his advisor **Prof. Adam Bates’** NSF CAREER Award, Hassan created a system he calls NoDoze to judge whether a potential threat needs attention based on just how unusual it is. If it isn’t a true anomaly, it might not be a real threat at all. Hassan also won a fellowship from **Symantec Research Labs** to support his security-related work.



COMPUTATIONAL GEOMETRY

Profs. Timothy Chan, Jeff Erickson, and **Sariel Har-Peled** give Illinois CS three globally recognized experts in computational geometry, in both research and education. That strength was on display in 2019 at the 35th International Symposium on Computational Geometry. Between them, Chan, Erickson, and Har-Peled co-authored eight papers presented at the conference. Erickson also released a textbook, *Algorithms,* based on his widely-used lecture notes.

FIRST-EVER BRACKET GENERATOR FOR NCAA WOMEN'S BASKETBALL

Prof. Sheldon Jacobson and his students created the first-ever bracket generator for the NCAA Women's Basketball Tournament, comparing the likelihood that a set of seeds will reach a particular round of the tournament.

COMPUTER ARCHITECTURE

Illinois CS has a longstanding leadership position in computer architecture through the standard-setting research of **Profs. Sarita Adve** and **Josep Torrellas,** but also through service. Adve (Steering Committee SIGARCH chair), Torrellas (Steering Committee TCCA Chair), and **Prof. Christopher Fletcher** (Program Committee member) all served in leadership roles at the 2019 International Symposium on Computer Architecture in June. Between Illinois CS and ECE ILLINOIS, the U of I had more papers accepted at ISCA than any other institution.

UNLEASHING THE POWER OF SPECIALIZED AND RECONFIGURABLE HARDWARE

THE ELECTRONICS RESURGENCE INITIATIVE

Professors Sarita Adve, Vikram Adve, Christopher Fletcher, and **Sasa Misailovic** are part of research teams chosen by **DARPA’s** five-year, $1.5 billion **Electronics Resurgence Initiative** to explore the development of flexible architectures capable of using specialized hardware to solve specific computing problems more quickly and efficiently.

COMPUTER VISION

Driven by the deep-learning revolution, computer vision has boomed and begun to transform photography, social and interactive computing, manufacturing, health care, the construction industry, and agriculture. With **Profs. David Forsyth, Derek Hoiem,** and **Svetlana Lazebnik,** Illinois CS has an unusually high concentration of researchers in computer vision, who, with our widening network of alumni, are among the leaders driving and shaping the growth of the field. The Vision Group is pushing research boundaries on everything from image synthesis and manipulation to joint models for image-language understanding and the creation of 3D scene models from photographs. ***Read more:*** *go.cs.illinois.edu/vision-leaders*

Members of Sarita Adve's research group. Back row, from left: Wes Darvin, Muhammad Huzaifa, Gio Salvador, Adel Ejjeh. Front row, from left: Weon Taek Na, Sarita Adve, Abdulrahman Mahmoud, Radha Venkatagiri.

RESEARCH ON MEMORY CONSISTENCY MODELS,INFLUENCE RECOGNIZED WITH KENNEDY AWARD

Prof. Sarita Adve received the 2018 ACM/IEEE-CS Ken Kennedy Award from the Association for Computing Machinery and IEEE Computer Society in recognition of her influential work and leadership at the interface of hardware and software. Adve co-developed the memory models for C++ and Java, and more recently she and her students questioned the conventional wisdom for memory models for heterogeneous systems. She is the third Illinois CS professor to win the prestigious Kennedy Award in the past nine years, joining 2010 winner **David J. Kuck** and 2016 winner **William D. Gropp.**

90 WORLD-CLASS FACULTY

DEPTH & BREADTH
FACULTY BY RESEARCH AREA

(Counts recognize faculty doing research across multiple areas.)

Architecture, Compilers, and Parallel Computing	13
Artificial Intelligence	18
Bioinformatics and Computational Biology	7
Computers and Education	14
Database and Information Systems	8
Interactive Computing	10
Programming Languages, Formal Methods, and Software Engineering	14
Scientific Computing	9
Security and Privacy	14
Systems and Networking	16
Theory and Algorithms	15

15 ACM Fellows

17 IEEE Fellows

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

36 NSF CAREER Awards

18 Endowed Chairs and Professorships

8 Sloan Research Fellows

MORE NSF FUNDING

Illinois was awarded more NSF Funding than any other University in 6 of the last 8 years

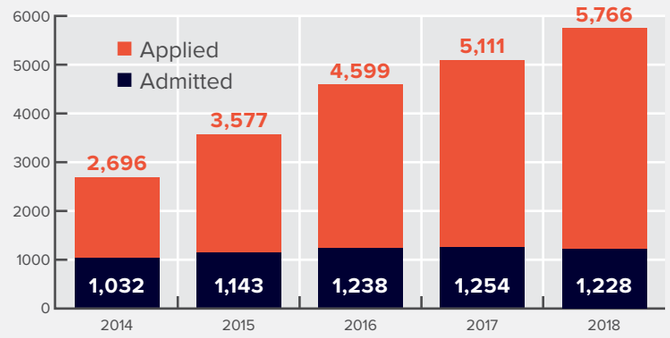
15,310 DEGREES CONFERRED TO 14,040 ALUMNI

BS	MS	PhD
9,421	4,461	1,428

$19.1 MILLION ENDOWMENT PROVIDES SUPPORT FOR:

Faculty Chairs, Professorships, & Awards	$10,038,300	Research Support	$1,201,122
Graduate Fellowships & Awards	$3,972,673	Distinguished Lectures	$71,678
Undergraduate Scholarships & Awards	$2,943,183	General Support	$848,584

UNPRECEDENTED UNDERGRADUATE DEMAND, TALENT, & DIVERSITY



35 STATES REPRESENTED
(ENROLLED UNDERGRADUATES, FALL 18)

33.5 INCOMING ACT
(COMPOSITE AVERAGE)

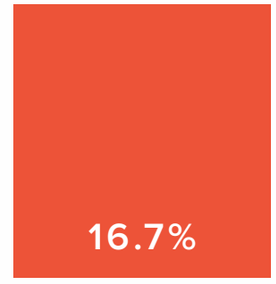
70.2% MALE / 29.8% FEMALE
(ENROLLED FRESHMEN, FALL 18)

$99,741
Average Starting Salary Reported by Baccalaureates Who Graduated During Academic Year 2017-2018

SPRING 2019 ENROLLMENTS

Computer Science	973
Five Year BS/MS	19 / 5
Five Year BS/MCS	26 / 34
Mathematics & Computer Science	265
Statistics & Computer Science	260
CS + Advertising	1
CS + Anthropology	33
CS + Astronomy	40
CS + Chemistry	35
CS + Crop Sciences	5
CS + Economics	10
CS + Geography and GIS	1
CS + Linguistics	71
CS + Music	1
MCS	77
Online MCS / MCS in Data Science	716
MS	115
MS in Bioinformatics	7
PhD	324
Total Undergraduate Enrollment	1,740
Total Graduate Enrollment	1,286

TOTAL UNDERGRADUATE FEMALE ENROLLMENT



FALL 2014

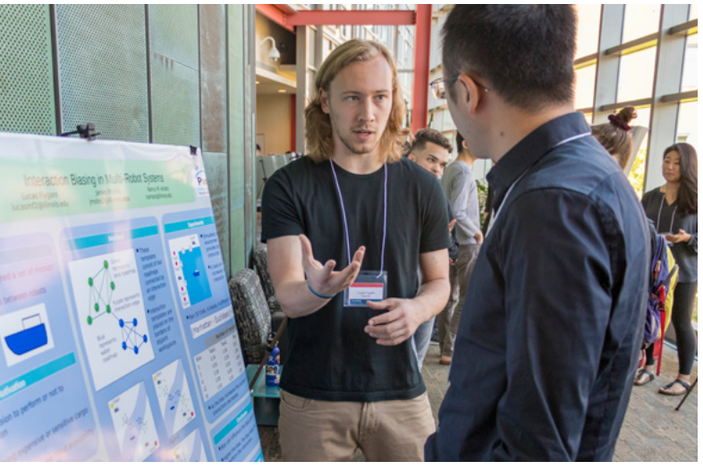
FALL 2018

$17.7 MILLION
in Support from the State of Illinois, FY18

$32.3 MILLION
in Research Expenditures for FY18

$3.0 MILLION
in New Gifts

INNOVATING EDUCATION



SUMMER REU PROGRAM OPENS RESEARCH TO UNDERGRADUATES

Illinois CS launched its first formal Research Experience for Undergraduates (REU), a summer program in which students work with Illinois faculty mentors and graduate students to get an introduction to CS research. The 10-week program drew more than 50 students per week to seminars covering research skills, presentation skills, information about graduate school, and how to apply for graduate studies.

GROUNDBREAKING CS+X DEGREES EXPAND INTO ADVERTISING, ECONOMICS, GIS, & PHILOSOPHY

The roster of revolutionary CS + X degrees grew with the additions of bachelor's degrees in CS + Advertising, CS + Economics, CS + Geography & Geographic Information Science, and CS + Philosophy. Illinois leads the field in CS + X, which offers a solid foundation in computer science with training in the arts or sciences that allows students to bring computational skills to fields where they are increasingly in demand. The four new degrees join majors in CS + Anthropology, CS + Astronomy, CS + Chemistry, CS + Crop Sciences, CS + Linguistics, CS + Music, Mathematics & Computer Science, and Statistics & Computer Science.

C3.AI PROVIDES INNOVATIVE ACCESS TO ILLINOIS MASTER OF CS IN DATA SCIENCE

C3.ai, led by alumnus **Tom Siebel,** is now reimbursing the cost of an Illinois CS Master of Computer Science degree focused on data science for any employee who is admitted to the program. The company will then go a step further, giving any of those employees who complete the degree program a 15% percent raise, $25,000 bonus, and a C3 stock option equity award. "This program further enables our employees' success by encouraging them to further develop their computer science and AI expertise at one of the world's leading universities," Siebel said.

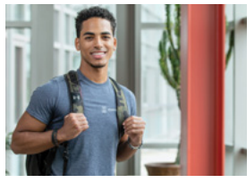
CS STUDENTS GET A TASTE OF MAJOR LEAGUE TECH AT CITY SCHOLARS

City Scholars links tech talent from Illinois CS and across The Grainger College of Engineering to Chicago companies like **JPMorgan Chase** and the **Chicago Cubs.** Illinois CS student **Vraj Patel** was part of a two-student team with ECE student **Thomas Ng** that Cubs VP of Technology **Andrew McIntyre (BS MechE '96, MBA '99)** says "started to actually outperform the consulting company that we had hired. We are definitely interested in continuing with the City Scholars program." **Steve Benni (BS CS '00),** who is Executive Director in JPMorgan Chase's Chief Technology Office in Chicago, says City Scholars interns were able to automate a job that before took about 2,000 working hours to complete each year.

ECE ILLINOIS student Thomas Ng (left) and Illinois CS student Vraj Patel at Wrigley Field in Chicago.

THE IMPACT OF PHILANTHROPY

Generous support from alumni, friends, and corporate partners helps Illinois Computer Science to provide: student scholarships and fellowships, endowed faculty positions; support for faculty teaching and research; funding to send students to present research at conferences and to participate in technical competitions; funds to bring industry experts to campus for lectures and advising; and support for K-12 outreach programs. Private support serves as a measure of the department's strength, impacts our national rankings, and gives the agility to respond to opportunities. In 2018-19, Visionary scholarships provided large, renewable scholarships to 14 Computer Science undergraduates, like sophomore **Jacob Perakis.**



"This scholarship made it possible for my family to send me, my brother, and my sister to college for an affordable price. We are on track to be the first in our family to complete a college degree."

– Jacob Perakis

EMPOWERING VISIONARY YOUNG MINDS

WITH ILLINOIS | THE CAMPAIGN FOR ILLINOIS

The Grainger Matching Challenge continues to support the The Grainger College of Engineering's $100 million Visionary Scholarship Campaign through December 2019, by giving donors the opportunity to double or quadruple scholarship gifts.

AJA CAPEL BECOMES NCWIT CHAPTER'S FIRST NATIONAL AWARD WINNER

Urbana High School's **Aja Capel** became the first member of the Central Illinois chapter of NCWIT Aspirations, which is hosted by Illinois CS, to receive a national award from the organization. She was chosen from among a record 4,300 applicants from across the country. Aja, who will be a high school senior in 2019-20, is already taking online college classes and eventually hopes to go to veterinary school, combining engineering with a veterinary medicine degree to make animal prosthetics.

Aja Capel, center, with her father, Parrish Capel, and her mother, Dr. Shawn Love.

BRINGING THE FIELD TOGETHER

INDUSTRY / FACULTY / STUDENTS / ALUMNI

THE CLIMATE CORPORATION INVESTS IN ILLINOIS' CS + CROP SCIENCES MAJOR

Reflecting the growing demand for employees prepared to work in tech at agricultural companies, **The Climate Corporation** has invested $500,000 in the first-of-its-kind CS + Crop Sciences major. The funding will be provided over five years and provide scholarships to CS + Crop Sciences students. "With our partnership, we aim to help accelerate growth at the interface of these disciplines because that's where transformational breakthroughs occur," said **Sam Eathington (Agronomy BS '91, MS '92, PhD '95),** the company's chief science officer.

CORPORATE CONNECTION
CS-ECE industry affiliates program

The Department of Computer Science and the Department of Electrical and Computer Engineering 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.

35 **CORPORATE AFFILIATES**

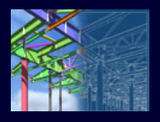
STARTUP AFFILIATES **22**

90 **CORPORATE EVENTS**

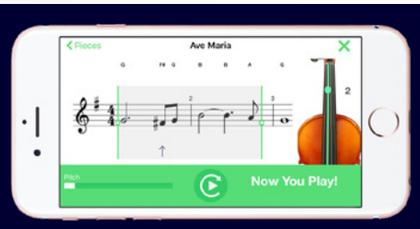
ENTREPRENEURIAL ECOSYSTEM

Illinois Computer Science and the University of Illinois at Urbana-Champaign offer a fertile base for faculty and students to turn their ambitions and ideas into businesses.

RECONSTRUCT BACKED BY $7.7 M FINANCING ROUND



Reconstruct, co-founded by **Prof. Derek Hoiem,** continues to be one of the most successful startups connected to Illinois CS. In 2019, the firm – which uses images to create 3D modeling for construction management – attracted a $7.7 million Series A round led by **Cultivation Capital.** Reconstruct also was named one of ***Crunchbase's*** **50 Hot Tech Companies Globally in 2019.**



VENTURE BACKING HELPING FINE-TUNE TRALA

Vishnu Indukur (BS CS '16) co-founded **Trala** while he was still a student. Now the CTO, Indukur, his Chicago-based company, and its app aimed at those who want to learn the violin are growing. In 2018 Trala landed $1.29 million seed funding, including backing from **LinkedIn CEO Jeff Weiner.**

DISTINGUISHED LECTURE SERIES

Every year the Illinois CS Distinguished Lecture Series brings prominent leaders and experts to campus to share their ideas. It includes the **Donald B. Gillies Memorial Lecture,** which honors the memory of a renowned CS faculty member, and the **Robert Mueller-Thuns Lecture,** which honors the memory of a graduate who died at a young age.

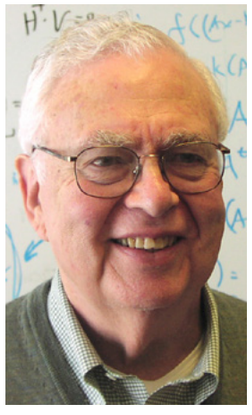
In October, University of California, Berkeley Computer Science **Professor Alexei (Alyosha) Efros** delivered the Donald B. Gillies Memorial Lecture, speaking on "Self-Supervised Visual Learning and Synthesis." Efros' research is primarily focused on data-driven computer vision, as well as its projection onto computer graphics and computational photography.

Other speakers in the 2018-19 Distinguished Lecture Series: **Luiz Andre Barroso** (Google); **Lexing Ying** (Stanford University); **Tamara Kolda** (Sandia National Laboratory) - Robert Mueller-Thuns Lecture; **Omer Reingold** (Stanford University); **Kunle Olukotun** (Stanford University); **Venkatesan Guruswami** (Carnegie Mellon University); **Sean Follmer** (Stanford University); **Jennifer Mankoff** (University of Washington); **Luca Trevisan** (University of California, Berkeley).

HACKILLINOIS DRAWS MORE THAN 1,000, INCLUDING AN OPEN-SOURCE PIONEER

Open Source Initiative co-founder **Bruce Perens** was among the more than 1,000 people at the 2019 edition of **HackIllinois.** Participants came from 43 universities including MIT, UCLA, and Georgia Tech, and they were able to work with about 100 industry mentors, including representatives from **Google, Facebook, Mozilla, and Caterpillar.**

HackIllinois is one of several amazing events led by our eight CS-affiliated student groups.



Alumnus and Distinguished Achievement Memorial Award winner Gene Golub.

DISTINGUISHED ALUMNI

Illinois Computer Science recognizes the accomplishments and impact of its faculty and alumni every fall, like revered **Professor Gene Golub,** who was honored with our Distinguished Achievement Memorial Award in 2018. Golub (BS Math '53, MA Stats '54, PhD Math '59) was a cofounder of the Stanford University Computer Science Department. Golub, who died in 2007, was widely known for creating algorithms and software that allowed researchers to run large engineering and scientific calculations effectively on computers. He was a member of both the National Academy of Science and the National Academy of Engineering.

In 2018, we also honored **Vilas Dhar** for Early Career Achievement; **Doug MacGregor** for Distinguished Alumni Achievement; **Ron Cytron, Won Kim,** and **David Lassner** as Distinguished Educators; **Ross Erlebacher** for Distinguished Service; **Matthew Sinclair** and **Dimitrios Skarlatos** with David J. Kuck Outstanding Thesis Awards; and **Ranjitha Kumar** with the C.W. Gear Outstanding Junior Faculty Award. To learn of their accomplishments, visit cs.illinois.edu/alumni-awards.

GROUNDBREAKING RESEARCH. INNOVATIVE EDUCATION. WE'RE TACKLING TOUGH SCIENTIFIC CHALLENGES – FROM ADDRESSING NEW SECURITY THREATS TO LAYING THE FOUNDATIONS OF DATA MINING. AND WE'RE MAKING A CS EDUCATION AVAILABLE GLOBALLY, WHILE APPLYING IT TO NEW FIELDS. EVERY DAY, ILLINOIS COMPUTER SCIENCE STUDENTS, FACULTY, STAFF, AND ALUMNI ARE LEADING THE WAY.

WE DO THE IMPOSSIBLE EVERY DAY.

DEGREE PARTNERS

College of Agricultural, Consumer, & Environmental Sciences

College of Engineering

College of Fine and Applied Arts

College of Liberal Arts & Sciences

College of Media

ILLINOIS
Computer Science
GRAINGER COLLEGE OF ENGINEERING

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