

USC Viterbi Magazine

FALL 2024



Select all squares where

brilliant computing happens

Click **Fight On!** once there are none left.

THE NEW USC SCHOOL OF ADVANCED COMPUTING



A place where humans reside at the center.



FIGHT ON!

A NEW HOME FOR THE USC SCHOOL OF ADVANCED COMPUTING



BY CAITLIN DAWSON

PHOTOGRAPHY BY STEVE COHN

ON SEPTEMBER 17, USC CELEBRATED the opening of the Dr. Allen and Charlotte Ginsburg Human-Centered Computation Hall. Designed by renowned architecture firm HOK, the LEED Platinum-certified building serves as a physical embodiment of USC’s mission to infuse computing with disciplines across the university, strengthen core computer science, and advance the ethical, social and “human-centered” dimensions of computing.

The new building is a “home for the next generation of creators, inventors and discoverers,” said USC President Carol Folt, and central to the university’s historic Frontiers of Computing “moonshot,” a more than \$1 billion initiative that supports ethical advancement in areas such as artificial intelligence, robotics and advanced computing. It was made possible by a naming gift from philanthropists Allen and Charlotte Ginsburg, first announced in 2020.

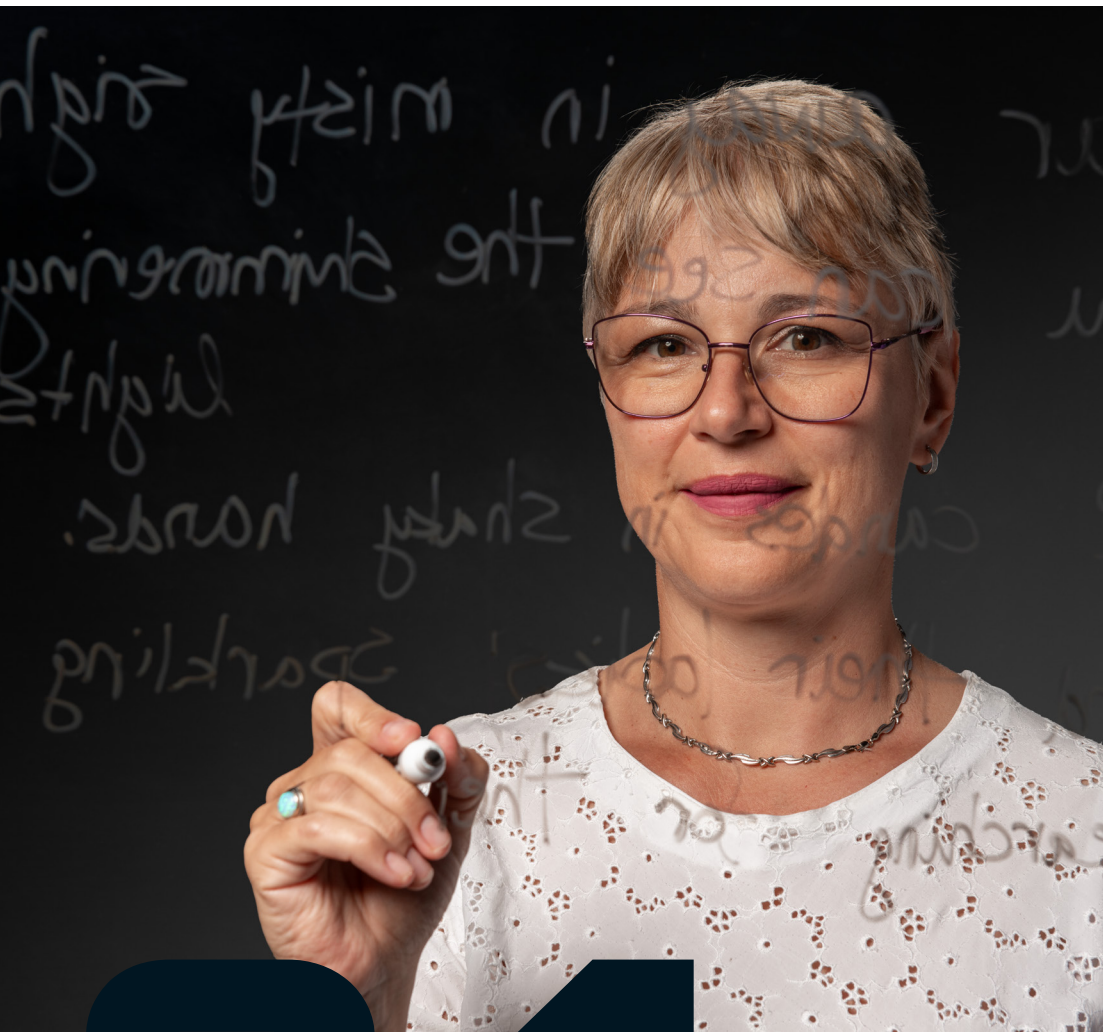
The cutting-edge hub — a 116,000-square-foot, seven-story structure featuring a striking glass facade — houses a two-story lab dedicated to the research and testing of flying autonomous aerial vehicles; advanced, open-plan robotics labs; student collaboration labs and creativity zones; and a 300-seat auditorium and amphitheater. It will also serve as a dynamic “living lab,” allowing researchers to study how the building operates in real-life conditions and explore and implement eco-friendly practices.

The design supports the Ginsburgs’ firm belief in the power of computing to change the human condition and of creativity to advance the prospects for humanity.

Ginsburg Hall completes a campus trifecta, joining the USC Michelson Center for Convergent Bioscience and the Ray Irani Hall for Molecular and Computational Biology. Together, these facilities will enable faculty and students to tackle today’s most pressing challenges, from cancer research to climate change. ■



Celebrating the ribbon-cutting are, from left: Professor Nenad Medvidović; Allen and Charlotte Ginsburg; USC President Carol Folt; USC Trustee Chair Suzanne Nora Johnson; USC Viterbi Dean Yannis Vortsos; and Director Gaurav Sukhatme of the USC School of Advanced Computing.



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'HUMAN CENTERED'
THE USC SCHOOL
OF ADVANCED
COMPUTING
IN 23 IMAGES

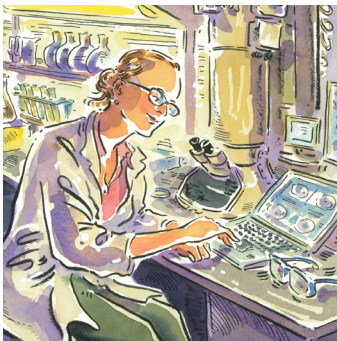
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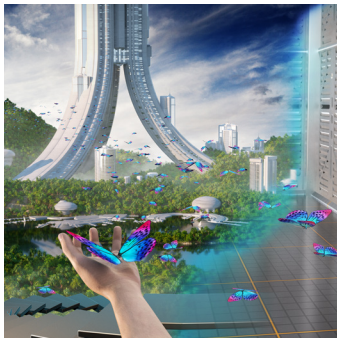
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USC Viterbi Magazine

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FALL 2024 VOLUME 24, ISSUE 1

USC Viterbi magazine is published twice a year for
the alumni and friends of the Viterbi School of Engineering
at the University of Southern California.

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‘All Disciplines Are Technology-Enabled Disciplines’

IN OUR INCESSANT QUEST to understand, humans — yes, I checked that I am not a robot! — have always used symbols, forms of representation and their manipulation to help extract meaning. The beautiful mathematics of many centuries, built on human ingenuity, have helped us understand fundamental aspects of nature, enhance scientific discovery, improve the human condition and bring increasing prosperity, global progress and self-actualization.

More spectacularly, though, in the very recent past, mathematics have ushered in extraordinary new technological innovation, most of it centered on computing, but with vast impact on everything, everywhere. In a fascinating twist, the mathematics of Newton and Maxwell, and, in the near future, of Schrödinger, have helped create physical devices and technologies that honor and further celebrate their progenitors, provided that they are given enough nourishment in the form of actual data. And such data is harnessed, processed and interrogated for meaning, insight and new advances, by sensors, devices and algorithms also created because we are standing on the shoulders of giants.

This autocatalytic process (can't help my inner chemical engineer), in which the speed of change of innovation is proportional to the state of innovation ($dI/dt \sim kI$), is, of course, Moore's Law, as a simple integration of the corresponding equation will give you an exponential ($I \sim e^{kt}$ — I hope I have not lost you here). This explains much of recent technological and computing progress.

But if we take this thinking a bit further, and make for a moment the simple modification that the speed of change of innovation is proportional to the square of the state of innovation ($dI/dt \sim kI^2$), then the resulting solution is a much faster change; in fact a hockey-stick type change, which mathematicians call a singularity (and, which, for nerdy completeness I must show here: $I \sim 1/(k(t_c - t))$). Futurist Ray Kurzweil has speculated, using different arguments, that approaching such a singularity is actually not far into the future. And, in fact, if one were to plot the number of data currently collected and analyzed from all kinds of digital sensors and devices, the resulting curve is very much that of a hockey stick (the $1/((t_c - t))$ behavior shown above). Which brings us to the centrality of computing in today's world.

Indeed, consider now that when appropriately harnessed, processed and analyzed — for example, through techniques such as data analytics, machine

learning and artificial intelligence — this data will help us solve long-lasting, grand challenge-like problems in health, sustainability or well-being. Or that it will provide new, unexpected insights to solve the complex problems of the social sciences. And, with my additional expectation that we will use the immense power of data processing inherent to these fast-rising new technologies to help usher in new science, based on this data processed (we humans always explored natural intelligence; this time we will explore the artificial). In a way to stand yet again on the shoulders of giants, except that this time, these figurative giants will consist of the seamless intertwining of technology and humanity, in a new, fascinating double helix.

It is with this emerging vision that we created the new USC School of Advanced Computing (SAC), a part of the USC Viterbi School of Engineering, but a true integral part of the entire university. The reason for this school-within-a-school reflects the fundamental duality of digital with the physical. Indeed, all data science, all ML, all AI, all quantum computing, are based on the fundamental physical processes taking place in devices and technological artifacts. Thus, SAC was created to be the home of not only the Thomas Lord Department of Computer Science, of Data Sciences, and the Information Technology Program, but also of the Ming Hsieh Department of Electrical and Computer Engineering (which is connected with invisible chemical bonds to computer science!). But with a drastic departure from academic orthodoxy, SAC will span all disciplines not only within the Viterbi School, but also across the entire university. This involves the creation of Affinity Faculty Groups across USC in areas such as health, sustainability, computational physical sciences, the arts, computational social sciences, and many more, including the study of unintended consequences of computational technologies, which are multiple and powerful.

They say that today all companies are technology companies. I would take one more step and expand it to say that with pervasive computing technologies, *all disciplines are technology-enabled disciplines*. SAC was created to make this vision a reality. ■

Yannis C. Yortsos

DEAN YANNIS C. YORTSOS

HECTOR, a USC robot, delivers scissors to USC President Carol Folt for the Ginsburg Hall ribbon-cutting ceremony. The September 17 event marked the opening of the new home for the USC School of Advanced Computing.



Do You Compute?

WHILE MOST PEOPLE worldwide have never needed and will never need to program a computer, modern computing technology affects everyone's lives to an unprecedented extent.

Computing mediates virtually every facet of life — substantial parts of how people communicate, work, shop, stay informed, consume entertainment, elect their governments, receive health care and organize their finances are conducted on a phone, tablet or desktop connected to the internet. And if you think computing is ubiquitous today, you haven't seen anything yet. With the infusion of artificial intelligence — witness the recent Nobel Prizes in physics and chemistry — future generations will live in a far more computationally driven world than we inhabit today.

Given this state of affairs, to call oneself a well-educated person today implies a reasonable understanding of how computers and computing work. We must reimagine how we educate students and ensure they leave the university with some knowledge of modern computing. This is quite different from turning

everyone into a computer programmer or chip designer and has to do with understanding what computational tools can (and can't) do, how to separate spurious claims from fact, and the tools to seek further information that is reliable and authoritative.

USC requires all students to complete general education requirements spanning various subjects. It is time to add a computing requirement to that list. Digital competency, which most USC students achieve already, will not do — our graduates need to be digitally fluent.

At the newly established USC School of Advanced Computing (SAC), we are building out new programs and courses designed to ensure that all students, irrespective of their major, have access to an education that provides digital fluency. This educational mission goes hand in hand with our mission to expand the frontiers of computing by recruiting the best faculty, thought leaders and innovators who will do their research here and invent the future of computing. In addition to substantially growing its two constituent academic departments — the Thomas Lord Department of Computer Science and the Ming Hsieh Department of Electrical and Computer Engineering — the SAC is designed to recruit scholars in advanced computing across the university.

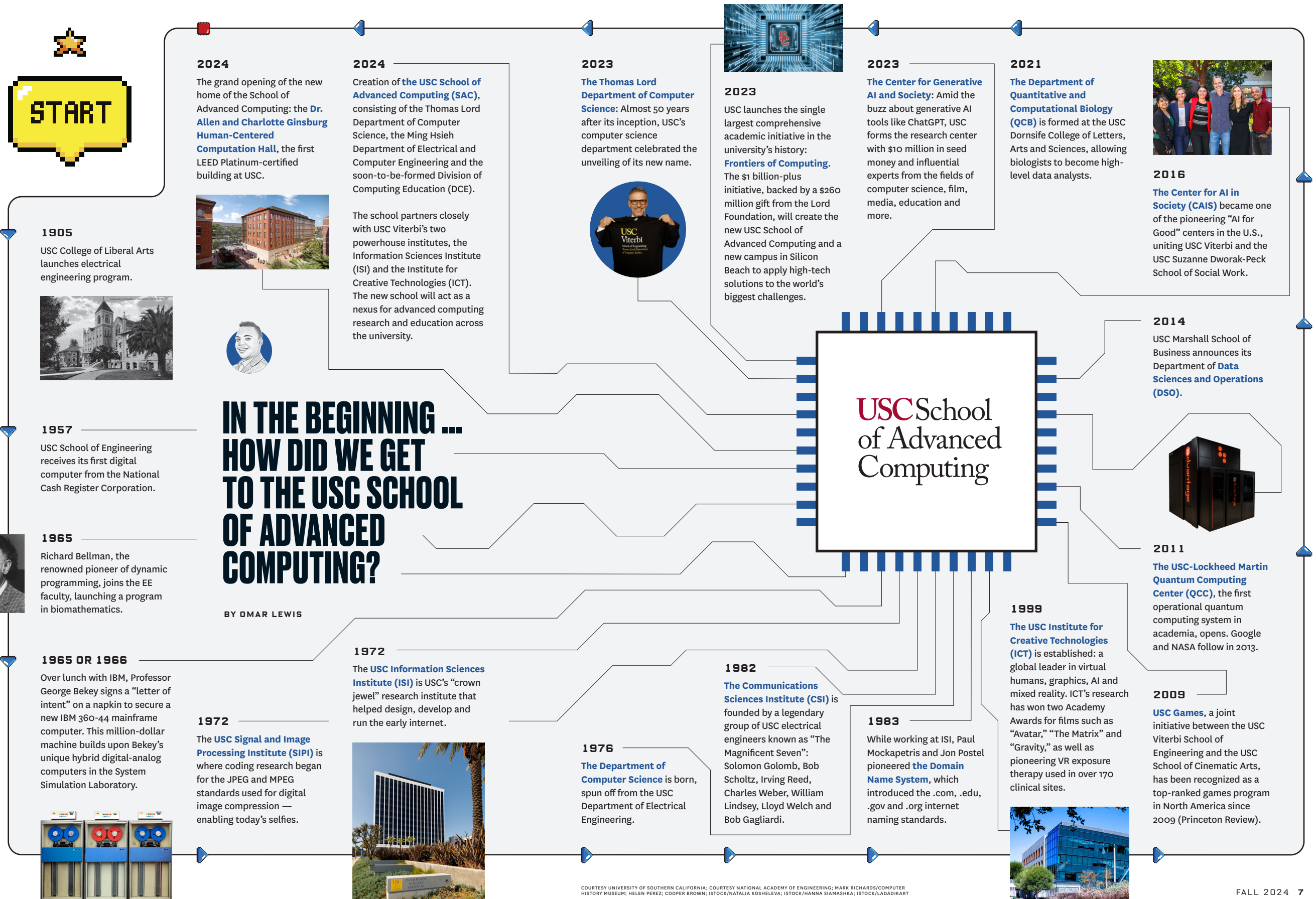
USC seeks to graduate students who can engage creatively with the modern world, enjoy productive professional lives and meaningfully contribute their talents to society. They will do so to maximal advantage if they are digitally fluent. It is the educational call of our time. ■

GAURAV S. SUKHATME

Director,
USC School of Advanced Computing

Executive Vice Dean,
USC Viterbi School of Engineering

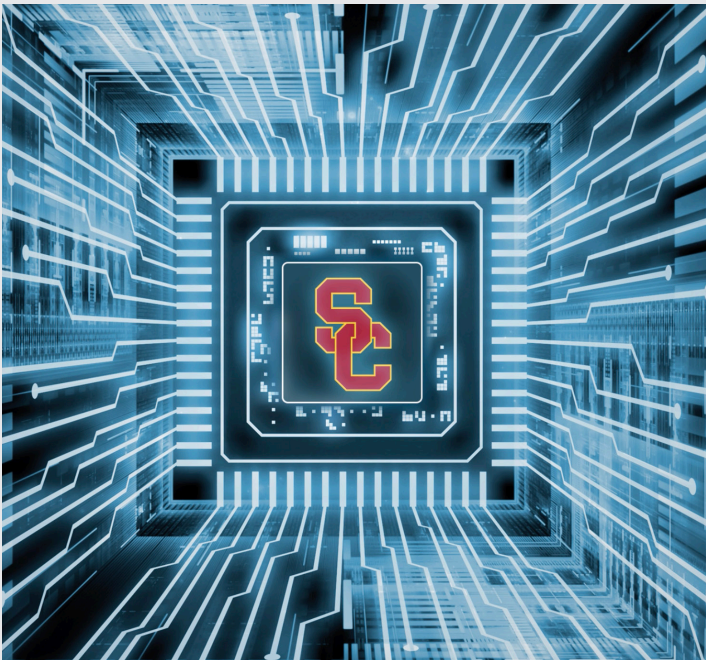
(From left) Yannis C. Yortsos, Allen Ginsburg, Charlotte Ginsburg, Gaurav S. Sukhatme celebrate the grand opening of Ginsburg Hall



BY THE NUMBERS

USC School of Advanced Computing

Building on a 50-year legacy in computing research, USC has launched the Frontiers of Computing initiative, a \$1 billion-plus investment to consolidate our leadership role in advanced computing research in artificial intelligence, machine learning and data science. The USC School of Advanced Computing, a unit of the USC Viterbi School, lies at its heart.



TOP 5 IN THE U.S.



For federal funding in computer science research, according to the National Science Foundation (NSF) in 2022, drawing more than

\$112
Million

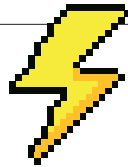
in research funds
(only seven U.S. universities received more than \$100 million)



Per U.S. News & World Report Rankings

IN U.S. GAME DESIGN PROGRAMS

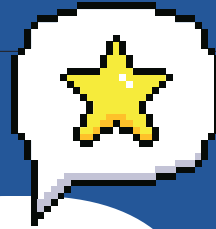
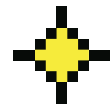




No.

FEEDER TO SILICON VALLEY

USC is the No. 2 feeder school for tech talent in Silicon Valley, according to a 2024 study from College Transitions. Based on public data from LinkedIn, Amazon is USC's top employer in the region.

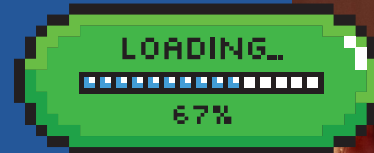


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LEVEL UP!

NEW FACULTY BY 2030

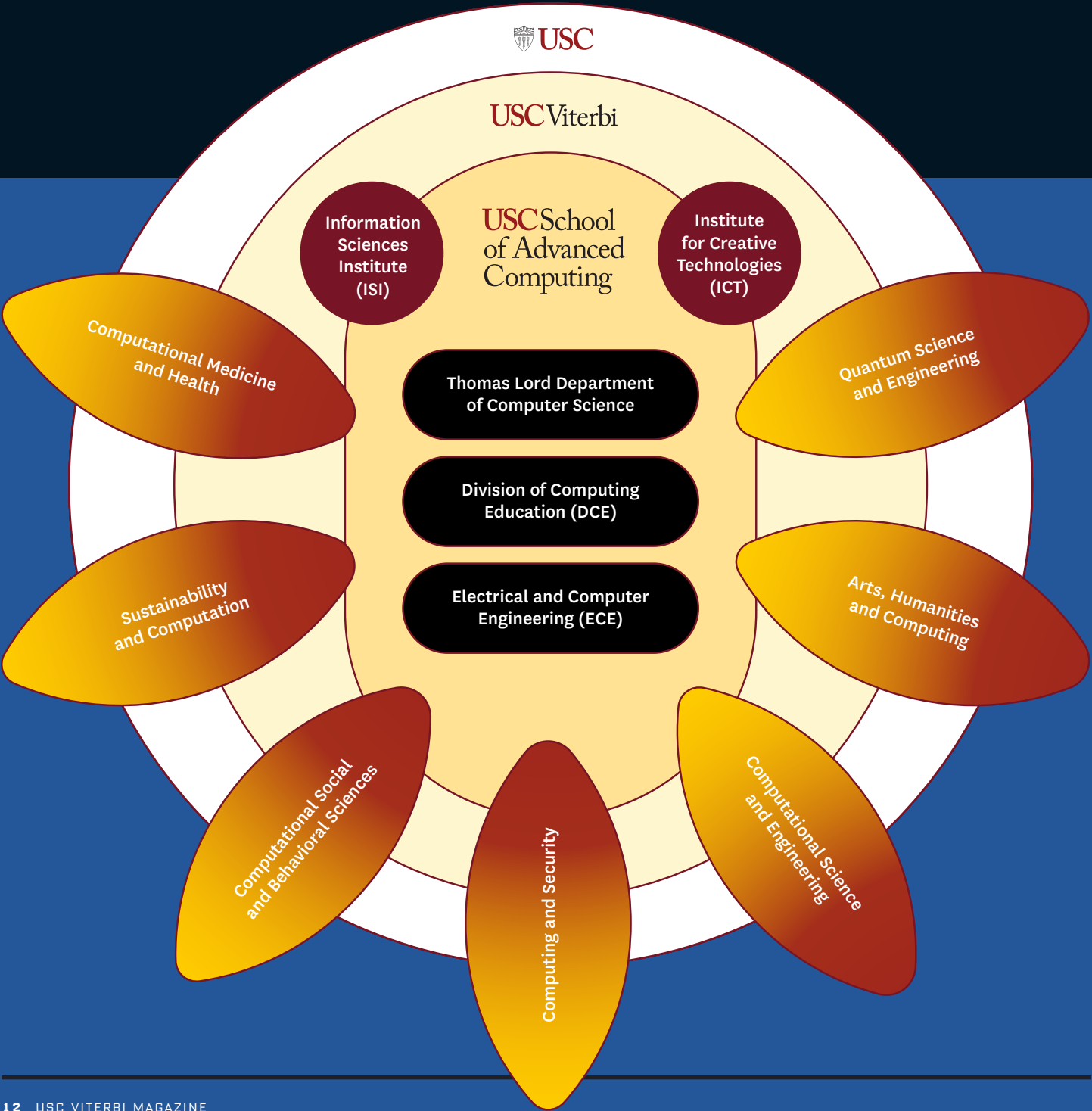
Supported by a \$260 million gift from the Lord Foundation, the USC School of Advanced Computing will see an influx of new talent: 30 new faculty members will be appointed in priority areas by 2027, and 60 will be recruited by 2030.



A School Within a School: The USC School of Advanced Computing (SAC)

How SAC fits within USC Viterbi and also spans across all 22 other USC schools, bringing computing to all Trojans.

ILLUSTRATION BY ROSE WONG



1

In 1983, USC Information Sciences Institute (ISI) researchers Paul Mockapetris and Jon Postel pioneered the Domain Name System, which introduced the .com, .edu, .gov and .org internet naming standards. What is the first domain name they created?

- (A) returnofthejedi.com
- (B) isi.edu
- (C) wargames.gov
- (D) sheblindedmewithscience.org

2

That same year, Fred Cohen demonstrated a self-replicating source code, which his USC advisor, Professor Leonard Adleman, coined as a:

- (A) "Decepticon"
- (B) "Virus"
- (C) "Walter Mondale"
- (D) "A Self-Replicating Source Code"

3

The USC Interaction Lab pioneered the field of socially assistive robotics in 2005. These robots assist people with:

- (A) Stand-up comedy
- (B) Selecting the optimal angle for selfies
- (C) The Cha-Cha Slide Challenge on TikTok
- (D) Rehab, autism, ADHD, depression, anxiety and healthy aging



1

The coldest spot on Earth might be:

- (A) The USC-Lockheed Martin Quantum Computing Center in Marina del Rey, Calif. (home of the first operational quantum computing center in academia). The D-Wave's processor temperature is a brisk minus 459.53 degrees F.
- (B) East Antarctica Plateau, Antarctica
- (C) Denali, Alaska
- (D) Häagen-Dazs headquarters, Minneapolis

5

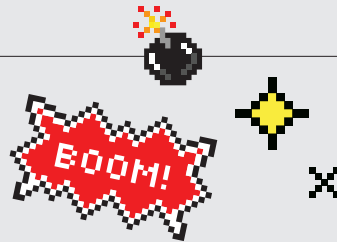
In a seminal paper, alumni Ashish Vaswani, (Ph.D. '14) and Niki Parmar (M.S. '15), laid the foundation for ChatGPT and other generative AI systems, introducing the transformer architecture. That 2017 paper was titled:

- (A) "Attention Is All You Need"
- (B) "Transformers: More Than Meets the Eyes"
- (C) "The Rise and Fall of Recurrent or Convolutional Neural Networks"
- (D) "How to Explain the Peloponnesian War in 30 Seconds or Less"

6

The USC Institute for Creative Technologies (ICT) pioneered many of the virtual humans and characters seen in movies. Which film did not use USC technology?

- (A) "Avatar"
- (B) "Furious 7"
- (C) "Spider-Man 2"
- (D) "Sharknado"



POP QUIZ

How Well Do You Know
Computing at USC?

9

In 2023, USC President Carol Folt launched the \$1 billion-plus USC Frontiers of Computing, which includes:

- (A) The new USC School of Advanced Computing
- (B) The Silicon Beach Campus in West L.A.
- (C) Hiring 60 new interdisciplinary computing faculty
- (D) All of the above

10

You can thank USC for today's selfies and the majority of digital images we share daily. The USC Signal and Image Processing Institute (SIPI) is where coding research began in digital image compression standards we know today as:

- (A) TIFF
- (B) JPEG and MPEG
- (C) PDF
- (D) EPS



QUOTABLE

What people are saying about the USC School of Advanced Computing (SAC).

“AI has been a transformative force across various industries, but its full potential in business is just beginning to unfold. Future business leaders need to bridge the gap between technical breakthroughs and real-world applications, and the collaboration between USC Marshall and the School of Advanced Computing will facilitate this.”

—Kimon Drakopoulos, associate professor of data sciences and operations, USC Marshall School of Business

“I want every student who comes through our programs, whether they are in science, business, the humanities or the arts, to have a solid grounding in technology and the ethics of the work that they do. We will integrate digital literacy across disciplines to create responsible leaders for the workforce of the future.”

—Carol L. Folt, USC president

“The School of Advanced Computing provides the critical infrastructure needed to design and test future models of health care that will depend on AI and quantum solutions, but will also require clinical, cybersecurity, legislative, regulatory privacy, equity, economic and sustainability experts. Having these experts under one roof is a brilliant and worthwhile undertaking.”

—Leslie Saxon, professor of medicine, Keck School of Medicine of USC; executive director, USC Center for Body Computing

“A USC sociology, history or dance major may not be attuned to the discipline of quantum computing, but the university’s School of Advanced Computing will help bring computing instruction to all students.”

LA Times

—Los Angeles Times (May 2023)

“The world needs engineers and computer scientists to solve the Grand Challenges we face. The new School of Advanced Computing will tackle this goal by developing reimagined engineering curricula that also emphasize the ethics of technology in our fast-changing world.”

—Yannis C. Yortsos, Dean, USC Viterbi School of Engineering

“Interdisciplinary work at the School of Advanced Computing may further individualized care, treatment, and the prevention of dance injuries for all ages, levels and abilities.”

—Margo K. Apostolos, professor, USC Kaufman School of Dance; co-director/co-founder of the Cedars-Sinai/USC Gloria Kaufman Dance Medicine Center

“The establishing of the School of Advanced Computing shows USC’s commitment to interdisciplinary research, which comes as the need for AI for social good continues to grow.”

—Leslie Moreno, USC Viterbi student and senior adviser and former president of CAIS ++, the student branch of the USC Center for AI in Society (CAIS)

“We want to develop a digital backbone across USC that touches every student and every graduate. So when they go out into the world, they understand what computing is.”

—Ishwar Puri, USC senior vice president of research and innovation

CHANGING COURSE

NATALIE FUNG

From PR to data science, **Natalie Fung**, a graduating master's student, on becoming a "double Trojan" after a life-altering accident.

PHOTOGRAPHY BY ALEXIS SITU

Editor's Note: As told to writer Anna Hsu, based on a conversation with Natalie Fung, a disability advocate and graduating master's student in communication data science.

I WAS 21 YEARS OLD when I broke my neck and became paralyzed from the chest down.

Up until this point, I had a relatively typical college experience. I was a student worker at USC Viterbi, I interned for a nonprofit that cleaned up beaches in Los Angeles, and I was about to start my first-ever paid internship for Nickelodeon.

During September 2013 — my last semester of college at USC as a public relations major — I went on a spontaneous weekend trip to Las Vegas with some of my friends. And on our way back to the hotel, a drunk driver hit our cab.

"LIFE AS I KNEW IT CHANGED."

After the accident, I had to get airlifted back home to L.A. I wasn't really moving at that point. I left school. Luckily, I had many supportive friends who helped me reach out to my professors, my jobs, and even my landlord, letting them know what had happened as I settled into my new normal.

I spent a month and a half at the Ranchos Los Amigos Rehabilitation Center doing inpatient rehab. I thought to myself, "There's no way I would be able to go back to school." Yet everyone at the rehab center was rooting for me, saying I could do it.

I finished my last three classes over Skype — before Zoom was a real thing — one semester at a time, in between physical and occupational therapy. In 2014, a year before I officially finished my degree, I got to attend commencement with my friends, which was bittersweet.

I looked for ways to get more involved in the disability community, eventually joining a wheelchair dance team called the Rollettes. I had never danced on a team before, but it was beautiful seeing how I could still dance in my wheelchair and meeting other young women with spinal cord injuries.



Natalie Fung, M.S. '24, and her dog, Roxy. Roxy likes the squirrels at USC and sleeping in class and dislikes fireworks and vegetables.

"BEFORE MY INJURY, I DIDN'T KNOW ANYONE ELSE WHO HAD A DISABILITY."

I didn't know what life would look like, and I didn't know if I could ever live independently again. But a lot of the girls had been injured for longer than me, so they were able to show me many aspects of their lives that helped me see what I was capable of.

I feel like many people have an expectation of what their life should look like. I wanted to go to undergrad, get an internship, get a job, live on my own, do this, do that. Within these specific goals, having a disability just came out of nowhere.

I didn't know if I could work; having a disability just wasn't something I saw a lot of 10 years ago in the media beyond evoking pity. Disability representation has grown much since then, although there's still lots of room to improve.

After a while, I started working part-time for USC Viterbi, back where I was once a student worker, and it felt nice to have a purpose in life again. At that point, I didn't know if I wanted to get back into public relations, so I looked at going to grad school.

"WHERE DO I GO FROM HERE?"

For a bit, I was looking at getting an MBA, but then I found out about the Communication Data Science joint program between USC Annenberg and USC Viterbi through Dean Yannis Yortsos. He said the program would line up well with my background in public relations and my interest in data science.

A lot of communication is very data-driven now, so I've really enjoyed learning the technical skills in the program but also brushing

up on communication fundamentals that I learned before.

Learning coding languages seemed daunting at first, especially coming from a non-technical field and being surrounded by people who have done this for far longer than me. These skills are increasing in demand at companies I've interacted with at career fairs and other events.

"IT'S SO SATISFYING TO USE DATA TO MAKE DECISIONS."

I was fortunate enough to receive a scholarship from Swim With Mike that allowed me to come back to school. Without it, I probably wouldn't be back at USC right now.

Since fall 2021, I've been involved with accessibility awareness on campus through the Viterbi Graduate Student Association, from partnering with the Graduate Student Government to put on a disability resource and awareness fair, to creating content on acquiring accommodations at USC.

I'm also a lab manager and research assistant in the Valero Lab under Professor Francisco Valero-Cuevas, where I previously helped him plan a conference held at USC in conjunction with the National Science Foundation. Four published papers on disability and rehabilitation engineering resulted from the conference!

I'm now being funded by NSF to see how a neuromorphic arm developed in the lab can be directly translated into real life.

When I was an undergrad, I thought I would already have a stable job with healthcare and my own house by now. But things change. And even though things didn't work out like I had originally planned, I can honestly say that I am looking forward to seeing where my new life takes me.

Coming back to USC has been a very full-circle experience.

Campus has changed a lot since I finished my undergrad and there's so much more diversity now compared to then. USC still has plenty of room to grow — for example, there aren't very many wheelchair-accessible housing units on campus. But seeing how welcoming campus has been to me, while it sounds cheesy, has felt so supportive.

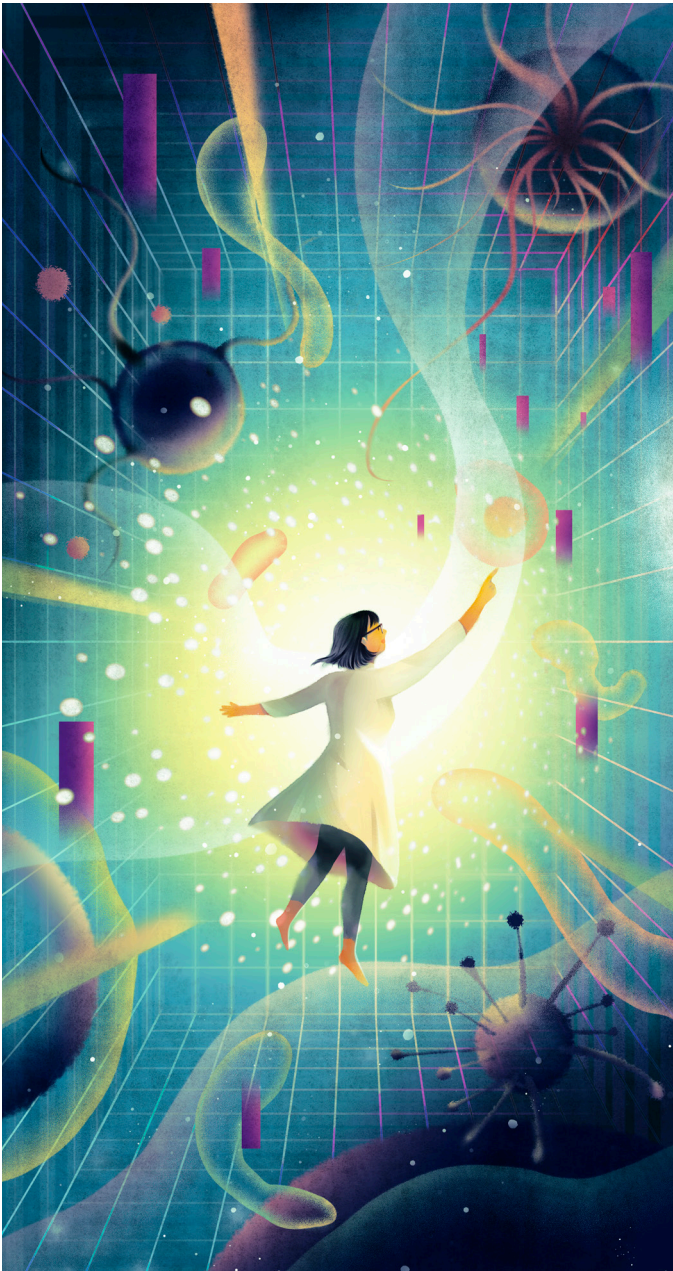
"I'M GLAD THAT I'M HERE TO BE A DOUBLE TROJAN." ■

COULD AI HELP US PREPARE FOR THE NEXT PANDEMIC?



Computer science doctoral student **Elizabeth Ondula** leverages AI to enhance pandemic response strategies.

BY MARIA VITTORIA BORGHI | ILLUSTRATION BY JASU HU



THE FIRST TIME Elizabeth Ondula thought about using technology to improve public health was when she faced a personal tragedy during the COVID-19 pandemic. Her father died, and she was unable to travel for his burial due to pandemic restrictions. “It was a challenging time,” said Ondula. “The travel restrictions made me wonder why public health policies are static, and how these strategies could be more adaptable to evolving conditions.”

Now a USC Viterbi Ph.D. student in computer science, Ondula’s research examines how policymakers and administrators can leverage AI to prepare for an infectious disease outbreak. This past February, Ondula presented her research on “Navigating Uncertainty in Epidemic Contexts with Reinforcement Learning” at the Association for the Advancement of Artificial Intelligence (AAAI) doctoral consortium.

“What this research brings to the table is an understanding of the impact of various policies,” said Ondula. “If you prepare and plan well, you can minimize the risk of serious illness or death, while responding to rapidly evolving conditions.”

Ondula’s application of AI, specifically reinforcement learning algorithms, to manage in-person attendance during epidemics offers “an important contribution at the intersection of public health, education and artificial intelligence,” said her advisor and co-author, Bhaskar Krishnamachari, a USC Viterbi professor of electrical and computer engineering and computer science.

Specifically, Ondula believes the tool could lead to faster and better implementation of hybrid policies for school, work, travel and help hospitals manage capacity issues due to surges.

By running theoretical scenarios, the tool could help policymakers and administrators better understand the impact of various possible decisions to find one that is “just right.”

AN EARLY WARNING SYSTEM

Ondula’s technology aims to determine how many people can safely access a public space, such as an office or a learning facility, during an epidemic. During COVID-19, school closures took 50 million children out of classrooms, erasing more than 20 years of progress on national test results, according to a McKinsey & Company report, a problem which is even more pronounced in poorer districts.

But how many students could have attended in-person classes at a minimal infection risk? Ondula’s work focuses on how environmental factors influence the answer to this question.

She is currently using stochastic epidemic models — mathematical models that simulate the spread of infectious diseases — and reinforcement learning techniques to map potential scenarios for a school semester. For example, Ondula’s AI could use real-time data to act as an early warning system and recommend when to limit building occupancy.

While epidemic models consider all predictable ways a disease can spread under certain conditions, such as transmission and immunity rate, stochastic models additionally factor in how people get sick by chance. This makes them particularly well-suited to predicting real-world scenarios, according to Ondula.

An important benefit of her concept is its applicability to any closed space. During COVID-19, for instance, hospitals hitting capacity needed to maximize space occupancy without knowing how their decisions could compromise patient safety. Ondula’s technology could provide an answer.

Moreover, the software can explore other epidemics, such as dengue fever, which spreads through mosquito bites. Ondula plans to make the technology open source, allowing researchers to run simulations with all kinds of models and settings. Next, Ondula will interview school administrators and policymakers to understand and resolve potential implementation issues. ■



Finding Hope Through the Browser Window

For a group of brave female students, USC Viterbi’s **Afghan Pathways Program** offers an educational lifeline they would otherwise be denied.

BY GRETA HARRISON

ILLUSTRATION BY ASHLEY KIM

“EVERYTHING ABOUT THIS COURSE is wonderful and extraordinary.”

“Before starting this class, I was sitting at home, unemployed and depressed. I was thinking about my future. What is going to happen? When do schools open? After the class, I was completely changed. I had no knowledge of coding because, in Afghanistan, coding is rarely taught. This made me focus on my studies all day, so I completely forgot about my pain.”

“This program has changed my life in an incredible way. It was a very useful and effective program for us Afghan girls in this difficult situation. We can have a bright future by learning coding.”

The words above come from anonymous young Afghan women who have been taking web development classes online via the USC Viterbi School of Engineering’s Afghan Pathways Program, a series of skills-based short courses offered for free by the Technology and Applied Computing Program, or TAC (until recently, it was known as the Information Technology Program), in partnership with the nonprofit HerFuture Afghanistan.

In August 2021, the Taliban regained control of Afghanistan. Around 15 million women and girls living in the country faced draconian new restrictions on their freedoms and their ability to participate in public life. They were banned from



In August 2021, the Taliban banned women in Afghanistan from attending university. Young female students are now continuing their studies online through USC Viterbi’s Afghan Pathways Program.

attending university or having jobs. After two decades of democracy, countless female workers — pilots, doctors, engineers, public servants — were forced to abandon their careers.

For HerFuture Afghanistan executive director Naheed Farid, the crisis facing Afghan women was personal. Farid was the youngest-ever elected politician and lawmaker in Afghanistan, taking office in the Afghan Parliament in 2010. After 2021, the Taliban refused to recognize her elected role, and Farid was forced to flee the country. She felt guilty about the constituents she left behind and was determined to find a way to continue fighting for the women and girls of her homeland.

“The situation on the ground is a suffocating crackdown on women. A gender apartheid,” Farid said. “Women are basically prohibited from any sphere of life. They cannot go out without a male chaperone. The legal and political establishment does not support women, so domestic violence, child marriage and forced marriage are on the rise. This is the life that women of Afghanistan are suffering through.”

However, for those wanting to regain some of their freedoms, there was one potential loophole: They could still study at home. Farid and her organization met with USC Viterbi Dean Yannis C. Yortsos to figure out a solution that could help the many young women who were placing their lives on hold.

“USC was the main organization that was brave enough to start helping women at the most sensitive time,” Farid said.

Through the Afghan Pathways Program, USC Viterbi professors Trina Gregory and Nayeon Kim meet remotely with students over 12 weeks,

teaching them how to create websites and code in Python. Female Afghan students have earned 161 certificates in web development and Python programming so far.

The process requires discretion. Participants must be vetted or referred by trusted sources to ensure the safety of all students. The students must then connect to the class with anonymous IDs not connected to their email addresses. On top of that, many students face infrastructure challenges, such as access to reliable internet and computers.

However, for some of those who have taken part, the program offers the critical career skills that could enable them to circumvent the restrictions they face and become self-sufficient. Farid said that some students have found jobs working from home, and others now can apply for overseas scholarships. Kim said that previous students in the program were also volunteering as learning assistants for the new cohort, with one student saving money to provide laptops for students who couldn’t afford them.

“The Afghan assistants are phenomenal. They are passionate about helping their peers and have built a community through this program that supports each other in their difficult situation,” Kim said.

USC Viterbi Afghan Pathways Program co-director Kendra Walther said, “This program provides such great learning opportunities, not only for the women on the ground in Afghanistan but for all of us at USC who get a glimpse into the courage, bravery and zest for learning of each of our participants.”

“The pathways program is not just a program,” Farid said. “When I talk to the women on the ground, they say, ‘When we look at the window of our laptop, this is the window of hope. It’s not just a screen.’” ■

According to the Pew Research Center, 41% of Americans have personally experienced online harassment. Transphobia, antisemitism and racism, including xenophobia, are among the most common forms of hate speech on social media.



Tweeting Hate for Love

X users who post hateful tweets are likely to become even darker online if they receive lots of positive feedback, a new study led by **Julie Jiang**, a recent computer science Ph.D. graduate, shows.

BY **MARC BALLON**

ILLUSTRATION BY **ADRIÀ FRUITÓS**

ONLINE HATE SPEECH and conspiracy theories can have deadly consequences.

Dylann Roof, the white supremacist who murdered nine Black congregants in a Charleston, S.C., church in 2015, was radicalized online. So, too, was Robert Bowers, the killer of 11 Jews at the Tree of Life synagogue in Pittsburgh in 2018. As was Payton Gendron, who gunned down 10 Black shoppers in a Buffalo, N.Y., supermarket massacre in 2022.

“We can draw a direct line from people’s exposure to hateful speech online and hateful actions and violence in

the real world,” said Megan Squire, deputy director for data analytics at the Southern Poverty Law Center.

According to the Pew Research Center, 41% of Americans have personally experienced online harassment. Transphobia, antisemitism and racism, including xenophobia, are among the most common forms of hate speech on social media, said Keith Burghardt, a computer scientist at the USC Information Sciences Institute.

So, what motivates the haters? More than a desire to emotionally harm their targets, they seek online “validation” in the form of likes, retweets and approving comments, said Julie Jiang, a recent Ph.D. computer science graduate who studied under Professor Emilio Ferrara.

“They want the love. That’s why they’re being hateful,” said Jiang, the lead author of the recent academic paper, “Social Approval and Network Homophily as Motivators of Online Toxicity.”

Jiang and her colleagues examined more than 1 million tweets posted by about 3,000 anti-immigrant users of X, formerly known as Twitter. They built a predictive machine learning model that considered the toxicity of a tweet and the number of likes a user’s post typically received, among other variables. Their conclusion: “The audience for an author’s hate messages [that appear nominally focused on some target minority] is like-minded online peers and friends, whose signals of approval reinforce and encourage more extreme hatred in an author’s subsequent messages.”

Jiang and her team’s study — the first to quantify whether hate speech can be a socially motivated behavior — was limited to X. However, she believes their findings could be extrapolated to other social media platforms. Additionally, Jiang said the positive feedback someone receives for becoming ever more hateful online could inspire others in their network to go darker themselves.

Perhaps most importantly, Jiang, a recent Forbes “30 Under 30” honoree, hopes the research might inspire social media companies to “change how they potentially can moderate hate speech in the future.” One idea: Disable likes for hateful tweets, depriving the nasty posters of attention — and love. ■

USC COMPUTING + INDUSTRY

Four centers, five companies:
asking tough questions about AI and privacy, finance, robots and education.

BY **LANDON HALL**

USC VITERBI has long partnered with the world’s most dynamic companies — sharing talent and ideas. The rapid evolution of artificial intelligence (AI), for all its head-spinning

innovations, has brought many concerns, among them sustainability, privacy and morality. What better way to examine these issues than for USC faculty members to get together with tech

leaders? Academia meets industry to tackle problems head-on. Here are a few of the corporate-sponsored AI centers that have been created in recent years at USC Viterbi:

amazon

USC-Amazon Center on Secure and Trustworthy Machine Learning

FOUNDED 2021

DIRECTOR **Salman Avestimehr**, *Dean’s Professor of Electrical and Computer Engineering and Professor of Computer Science*

MISSION Fundamental research on privacy, security and trustworthiness in machine learning, a crucial effort, given the proliferation of artificial intelligence across all aspects of our society.

RESEARCH The center has several research projects going that focus on “federated learning,” a method for training AI models that avoids using the personal health information of patients.

SIEMENS
TOYOTA

USC Center for Autonomy and AI (sponsored by Siemens and Toyota)

FOUNDED 2021

CO-DIRECTORS **Rahul Jain**, *professor of electrical and computer engineering, computer science, and industrial and systems engineering;*

Jyo Deshmukh, *associate professor of computer science and of electrical and computer engineering*

MISSION To lay the foundations for intelligent autonomy in close collaboration with industrial research partners.

RESEARCH Jain and Deshmukh are working on improving the learning methods of autonomous vehicles to prevent “corner cases,” situations the cars have not been trained to navigate.

Meta

Research and Education in AI and Learning (REAL) @ USC-Meta Center

FOUNDED 2022

DIRECTOR **Murali Annavaram**, *the Lloyd F. Hunt Chair of Electrical Power Engineering and professor of electrical and computing engineering and computer science*

ASSOCIATE DIRECTOR **Meisam Razaviyayn**, *the Andrew and Erna Viterbi Early Career Chair, associate professor of industrial & systems engineering, electrical engineering, and computer science*

MISSION To advance foundations for cooperative algorithmic optimization, hardware innovations for AI, and advance AI education accessibility.

RESEARCH Annavaram spent a year at Meta as a visiting researcher, and he brought what he learned back to USC. He’s trying to find ways to improve the energy efficiency and sustainability of large-scale AI systems.

Capital One

USC-Capital One Center for Responsible AI and Decision Making in Finance

FOUNDED 2024

DIRECTOR **Petros Ioannou**, *the A.V. “Bal” Balakrishnan Chair, University Professor of Electrical and Computer Engineering, Aerospace and Mechanical Engineering, and Industrial and Systems Engineering*

MISSION Home to some of the world’s leading minds in advanced computing, the center will explore how emerging technologies in AI and analytics can be applied to financial systems and services at scale, advancing cross-disciplinary knowledge between finance and technology.

RESEARCH The first center launched under the new School of Advanced Computing will take advantage of USC’s expertise in financial engineering to support research into AI, with the goal of solving some of the most challenging problems in financial services. ■

By carefully studying the behavior of past fires, USC researchers were able to track how each one started, spread and was eventually contained.

AI VS. WILDFIRE



Researchers have developed a new model that combines generative AI and satellite data to accurately forecast wildfire spread.

BY NINA RAFFIO

RESEARCHERS AT USC have developed a new method to accurately predict wildfire spread. By combining satellite imagery and artificial intelligence, their model offers a potential breakthrough in wildfire management and emergency response.

Detailed in an early study proof published in Artificial Intelligence for the Earth Systems, the USC model uses satellite data to track a wildfire's progression in real time, then feeds this information into a sophisticated computer algorithm that can accurately forecast the fire's likely path, intensity and growth rate.

The study comes as California and much of the western United States continue to grapple with an increasingly severe wildfire season. Multiple blazes such as the Park Fire — fueled by a dangerous combination of wind, drought and extreme heat — have raged across the state. As of August 2024,

nine of the 10 largest wildfires in California history have happened in the last seven years.

“This model represents an important step forward in our ability to combat wildfires,” said Bryan Shaddy, a doctoral student in the Department of Aerospace and Mechanical Engineering at the USC Viterbi School of Engineering and the study's corresponding author. “By offering more precise and timely data, our tool strengthens the efforts of fire-fighters and evacuation teams battling wildfires on the front lines.”

REVERSE-ENGINEERING WILDFIRE BEHAVIOR WITH AI

The researchers began by gathering historical wildfire data from high-resolution satellite images.

By carefully studying the behavior of past wildfires, the researchers were able to track how each fire started, spread and was eventually contained. Their comprehensive analysis revealed patterns influenced by different factors like weather, fuel (for example, trees, brush, etc.) and terrain.

They then trained a generative AI-powered computer model known as a conditional Wasserstein Generative Adversarial Network, or cWGAN, to simulate how these factors influence the way that wildfires evolve over time. They taught the model to recognize patterns in the satellite images that match up with how wildfires spread in their model.

They then tested the cWGAN model on real wildfires that occurred in California between 2020 and 2022 to see how well it predicted where the fire would spread.

“By studying how past fires behaved, we can create a model that anticipates how future fires

might spread,” said Assad Oberai, Hughes Professor of Aerospace and Mechanical Engineering at USC Viterbi and co-author of the study.

USING AI TO PREDICT WILDFIRES: IMPRESSIVE MODEL

Oberai and Shaddy were impressed that the cWGAN, initially trained on simple simulated data under ideal conditions like flat terrain and unidirectional wind, performed well in its tests on real California wildfires. They attribute this success to the fact that the cWGAN was used in conjunction with actual wildfire data from satellite imagery, rather than on its own.

Oberai, whose research focuses on developing computer models to understand the

underlying physics of various phenomena, has modeled everything from turbulent airflow over aircraft wings to infectious disease and how cells multiply within tumors and interact with their surroundings. Of everything he has modeled, Oberai notes that wildfires are among the most challenging.

“Wildfires involve intricate processes: Fuel like grass, shrubs or trees ignites, leading to complex chemical reactions that generate heat and wind currents. Factors such as topography and weather also influence fire behavior — fires don't spread much in moist conditions but can move rapidly in dry conditions,” he said. “These are highly complex, chaotic and nonlinear processes. To model them accurately, you need to account for all these different factors. You need advanced computing.” ■



PHOTO ESSAY:
'HUMAN CENTERED'

The USC School of Advanced Computing in 23 Images

BY ADAM SMITH

PHOTOGRAPHY BY
HUGH KRETSCHMER

Gaurav
Sukhatme

"Computing has changed the world in ways that were unimaginable when I started at USC as a graduate student more than 30 years ago," said Professor Gaurav Sukhatme, the inaugural director of the USC School of Advanced Computing.

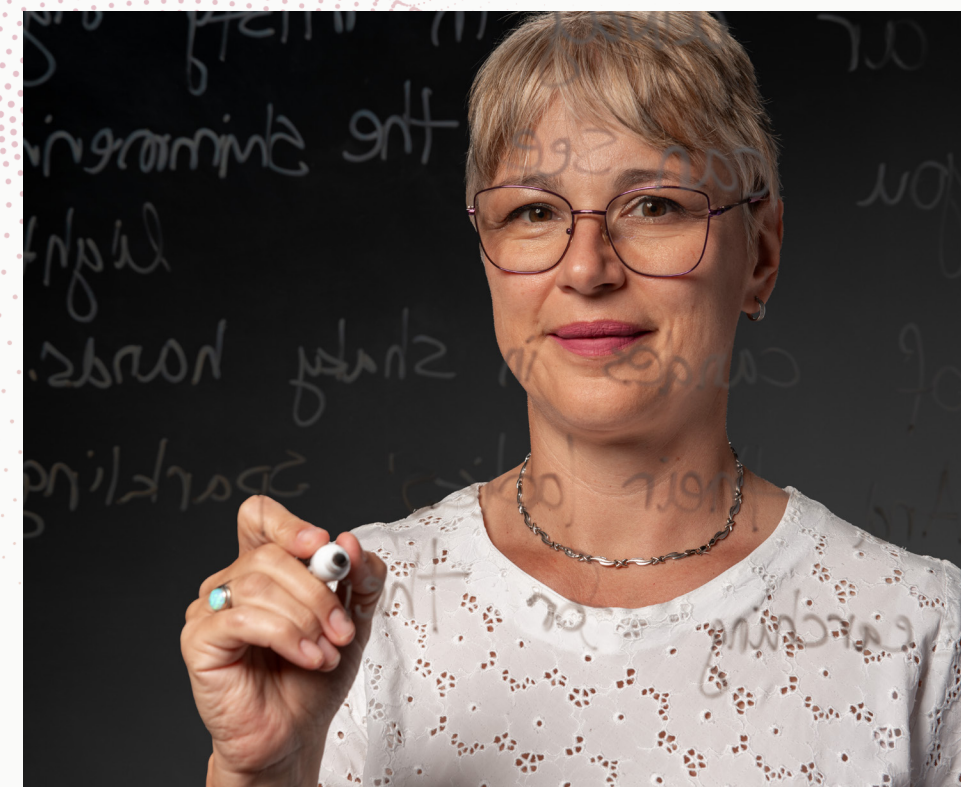


IF YOU GOOGLE "COMPUTING," you will soon be engulfed in images of circuit boards, robot heads and glacial blue lines of code. Nearly everything is cold and dark and vaguely dystopian.

In 23 images, this photo essay is an attempt to express some of the warmth, the humanity, behind the newly christened USC School of Advanced Computing. After all, the new school is located in the Dr. Allen and Charlotte Ginsburg Human-Centered Computation Hall.

Meet some of the Trojan engineers who wield 21st century computing power to aid, enable and inspire their fellow humans.

USC School of
Advanced Computing



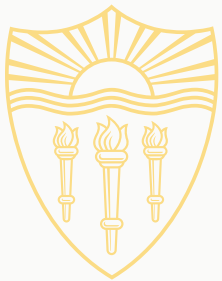
For the last decade, Jelena Mirkovic, USC Viterbi research associate professor of computer science, has studied the memorability and security of passwords, and the ways in which these two are often at odds. Mirkovic likes five-to-seven-word passwords or phrases — she is fond of writing poetry — often mixing languages like English and her native Serbian.

Jelena Mirkovic



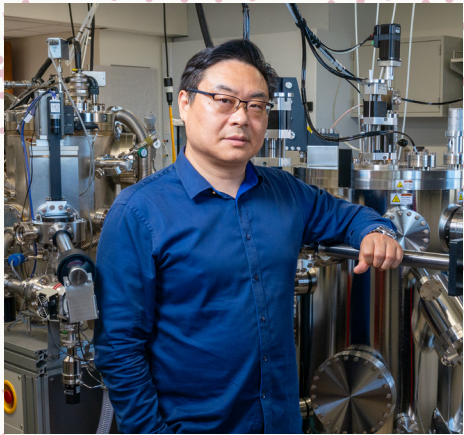
Alexander Spangher

Alexander Spangher, a Ph.D. student in computer science and former New York Times data scientist, enlists AI to help journalists in resource-challenged local newsrooms. For example, AI could review the minutes of thousands of city council meetings and suggest new story leads or ID new and diverse sources for those stories.



The co-director of the Center for AI in Society (CAIS) — one of the first “AI for good” research centers in the U.S. — Professor Bistra Dilkina (pictured here with her daughter) has leveraged AI to fight poachers, protect L.A.’s water supply in the event of an earthquake and study the potential of sea level rise to trigger mass American migration to inland cities.

Bistra Dilkina



Joshua Yang

“The brain is the most energy-efficient computer known so far — way better than any supercomputer,” said J. Joshua Yang, the Arthur B. Freeman Chair Professor in the USC Ming Hsieh Department of Electrical and Computer Engineering. He leads a five-university center on neuromorphic computing, seeking to unlock similar efficiencies for the energy intensive age of AI.



Yan Liu

Growing up in China, Professor Yan Liu’s father wanted her to become a doctor like him. Years later, when her father was diagnosed with prostate cancer, Liu partnered with the Keck School of Medicine of USC to design AI solutions to improve surgical training and create better patient outcomes. Said her father: “Maybe [my daughter] found the best way to help people and save lives after all.”



David Nelson

David Nelson, an award-winning film producer and director of the Mixed Reality Lab (MxR) at the USC Institute for Creative Technologies (ICT), has overseen projects like the Digital Interactive Victim Intake Simulation (DIVIS), a simulator to help train military sexual assault response coordinators so the stories of victims are heard and appropriately handled.



Andrea Belz

"I am a physicist by training, so I like grand unified theories; frameworks where everything fits together," said Andrea Belz, USC Viterbi vice dean of transformative initiatives. As director of translational strategy for California DREAMS — a \$27 million consortium of 16 universities and companies to boost microelectronics production for 5G/6G — Belz brings people together to build something bigger. "The whole is bigger than the sum of the parts."



Massoud Pedram is inspired by the outdoors, particularly lush, green landscapes. Unsurprisingly, his work in green computing has led to a coveted NSF Expeditions in Computing Award in 2022. He seeks to revolutionize computing devices with 100 times the energy efficiency or 10 times the processing speed.

Massoud Pedram



FeiFei Qian

FeiFei Qian adores snowboarding. One day she hopes to teach her lab's adventurous robot dogs how to snowboard, too. Her lab develops robots that "can traverse the most challenging terrains, while collecting information that can allow us to better understand our earth and other planets." Sponsored by NASA, they've already traveled 6,000 feet up Oregon's snow-capped Mount Hood.



Murali Annavaram

Professor Murali Annavaram is an L.A. anomaly — a bicycle commuter, riding over 5,000 miles each year. Passionate about both energy efficiency and privacy, Annavaram was inspired by his time as a visiting researcher at Meta, imagining ways to bring energy-efficient hardware to planetary-scale computer systems. Today, he is co-director of a Meta-backed research center, REAL@USC-Meta Center.

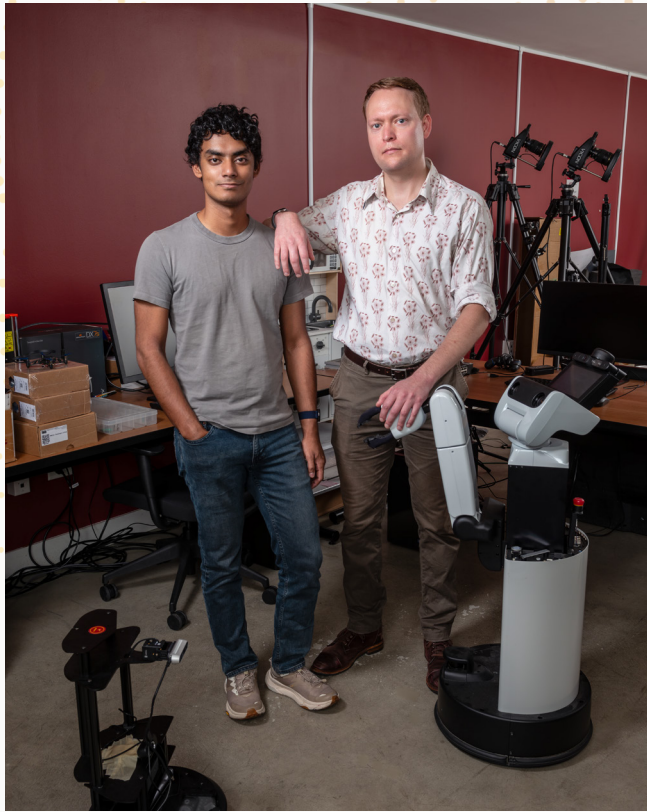


Salman Avestimehr

Professor Salman Avestimehr, electrical engineer, entrepreneur and pianist, revels in Rachmaninoff's Piano Concerto No. 2, which, like his work in collaborative machine learning, requires immense technical skill and virtuosity. Avestimehr is not only the director of the USC + Amazon Center on Secure & Trusted Machine Learning, but also an entrepreneur; his startup, TensorOpera, recently raised \$17.5 million in seed funding.

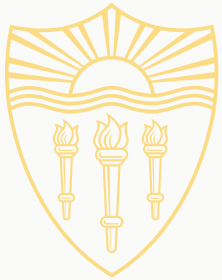
**Jesse Thomason
& Abrar Anwar**

In the GLAMOR Lab, led by Jesse Thomason, researchers like Abrar Anwar, USC Viterbi Ph.D. student, explore vision-and-language navigation (VLN) for robots: the task of translating natural language commands — like “go into the hallway and take a left at the second door to find the master bedroom” — into sequences of actions.



Jaspreet Ranjit

Can computing play a role in addressing homelessness? Jaspreet Ranjit, a Ph.D. student, won the Best Student Poster Award from the USC Center for AI in Society, collaborating with researchers in the USC Suzanne Dworak-Peck School of Social Work. Her team used large language models (LLMs) to analyze 2.4 million tweets about homelessness between 2021 to 2023 to aid advocacy groups with a better understanding of changing public attitudes. Ranjit also works alongside School on Wheels, an organization offering free tutoring services to children who are experiencing homelessness in the Greater Los Angeles area.



Abigail Horn, a computer scientist at the USC Information Sciences Institute (ISI), played the harp semi-professionally for several years just after college. Strings are a reoccurring theme in Horn’s work. Years ago, she found inspiration in a string sculpture at the Detroit Museum of Art. It reminds her of her current work with network diagrams, mapping things like the U.S. food system, understanding how local food environments affect eating behaviors and nutritional health.

Abigail Horn



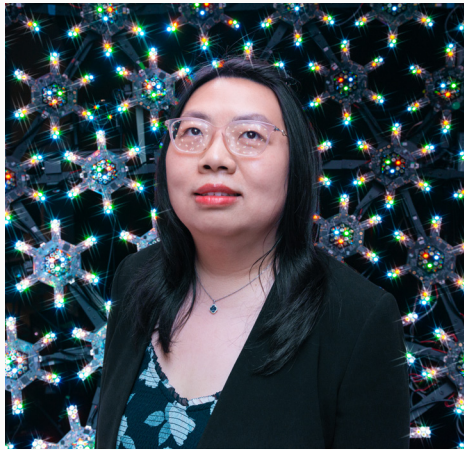
Saty Raghavachary

Saty Raghavachary, an associate professor of computer science practice, loves to draw and paint using unusual surfaces and pigments: plastic plates, sales receipts, alcohol inks and liquified crayons. The former Dreamworks Feature Animation software developer also likes to use CG to simulate natural phenomena such as water flowing, fire burning or objects breaking.



Federico Spedalieri

A fan of M.C. Escher’s “Relativity,” Federico Spedalieri recognizes that “sometimes things need to be looked at from different angles to be understood.” As operational director of the USC Quantum Computing Center, Spedalieri co-authored the first peer-reviewed scientific paper that proves “entanglement” — Einstein’s “spooky actions at a distance” — in USC’s D-Wave quantum processors.



Yajie Zhao

As director of the renowned Vision & Graphics Lab at the USC Institute for Creative Technologies, Yajie Zhao oversees the Light Stage, which has been used to create photorealistic virtual humans for nearly 50 films and TV shows, including “Avatar.” Zhao aims to “design AI solutions for 3D content creation for a virtual world.”



Jonathan May, principal scientist at USC Information Sciences Institute (ISI) is fascinated by languages – particularly, languages others don’t study or focus on. Among his projects: teaching an AI agent named Cicero to be strategic but persuasive in the board game Diplomacy; and personalized chatbots that act as your personal representative or learn improv comedy.

Jonathan May



Keith Burghardt

Computer scientist Keith Burghardt collects propaganda posters. They remind him of his work at the USC Information Sciences Institute (ISI) on how internet propaganda drives extremism and disinformation. He has developed techniques to detect hateful subreddits and quantified how the usage of hate keywords on Twitter nearly doubled after Elon Musk bought X, formerly Twitter.



Remo Rohs

In October 2024, the Nobel Prize in Chemistry was received by three scientists who used AI and computing to predict the shape of proteins and invent new ones. For Professor Remo Rohs, the founding chair of the USC Dornsife Department of Quantitative and Computational Biology, it was not a surprise: “I believe that all fields of biology will become increasingly reliant on computers, databases, mathematics and statistics. That’s why I call our department ‘a biology department of the 21st century.’ And from a different perspective: ‘an engineering+ department where the + encompasses biology and medicine.’”



Krishna Nayak

Led by Krishna Nayak, Dean’s Professor of Electrical and Computer Engineering, the Dynamic Imaging Science Center (DISC) houses a unique, high-performance, low-field MRI — one of only three of its kind in the world. “Low-field MRI has the potential to drive down the system cost and physical footprint so that MRI technology can be more accessible and reach more patients in need,” said Nayak.



Heather Culbertson

Heather Culbertson, WiSE Gabilan Assistant Professor of Computer Science, finds joy in tactile sensations like crocheting. Her work in virtual touch allows virtual environments to feel as real as the actual world. In 2016, her lab pioneered a virtual haptics sleeve that simulates the caress of a loved one using \$10 voice coils. ■

Computing for All

BY MARC BALLON

ILLUSTRATION BY
MARYSIA MACHULSKA

Memphis Johnston never saw herself as a STEM person. At her high school in Brooklyn, New York, she said she largely confined herself to the humanities partly because the overwhelming majority of math and science students and teachers were men.

At USC, Johnston took Journalism 494: Python Coding for Digital Journalism. Taught by Iris Lee, a former assistant editor at the Los Angeles Times' Data and Graphics desk, the class showed the 20-year-old public relations major the power of using data to create graphics to augment stories. It also demystified the process of gathering and analyzing data via digital tools.

Johnston began thinking about how a deeper understanding of data could help her professionally, whether she decided to become a public relations professional, lawyer or something else. In PR, she said, she could use data "to immediately parse [PR] campaigns and see what works, who the demographics are and where you should put resources based on your findings." If she went into copyright and tech law, Johnston said an understanding of data would increase her analytical skills and make her a better attorney.

So, Johnston decided to minor in the foundations of data science in the USC Viterbi School of Engineering's Technology and Applied Computing Program, or TAC. (Until recently, it was known as the Information Technology Program, or ITP.) She has so enjoyed her TAC classes, including an introduction to data science, that she now plans to apply to USC Viterbi's progressive degree program, which would allow her to earn a bachelor's degree in PR and a master's in communication data science in five years.

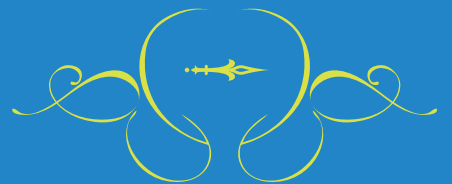
"Anything that you have that's even slightly STEM-related can be helpful, just because I think that's where the trajectory is kind of heading, at least for my generation," said Johnston, who spent the summer as an intern at the Office of the New York City Comptroller. "Having a data science background can be very helpful."

As the world enters the Fourth Industrial Revolution, the new USC School of Advanced Computing is teaching history, philosophy and English majors invaluable computing, AI and data science skills.



Lizzy Lourenco is another Trojan who decided to complement their non-STEM major with a technical minor. (Lizzy goes by they, them and their pronouns.) Lourenco graduated in spring 2024 with a B.F.A. in technical direction and a TAC minor in computer programming. Lourenco now has a coveted job with Tait Towers, a live entertainment production company that specializes in automation, scenery and staging for clients such as Taylor Swift, Cirque du Soleil and the Rolling Stones.

"I would not be the person I am today without this minor," Lourenco said. "Through [TAC], I was able to further explore my interests while developing my personal brand of technical artistry. I'm 1,000% sure that I would not be as effective in my current position with Tait without going through my minor or taking computer science courses at a university level."



FAQ ON SAC ... YOUR QUESTIONS ON THE NEW SCHOOL ANSWERED

Much ink has been spilled on the new USC School of Advanced Computing, or SAC. However, not everyone understands how transformative it promises to be — or even what exactly it is. Here are some answers to your burning questions.

Q I've heard a lot about the School of Advanced Computing. Are you folks in the Viterbi School's Communications and Marketing office just trying to rebrand the Department of Computer Science with a fancy name?

A No. It's like the Department of Computer Science on steroids to the power of

10. The centerpiece of USC President Carol Folt's Frontiers of Computing — a \$1-billion, 10-year initiative that supports the advancement of artificial intelligence, robotics and quantum computing within an ethical framework — the SAC will serve as the hub for advanced computing research and education for all of USC. As Gaurav Sukhatme, the school's inaugural

director, noted: "It's not enough for all USC graduates to be digitally competent. In a time when most companies are technology enabled, all USC graduates — from East Asian studies to engineering — must be digitally fluent." The school will be the "beating heart for all things computing" across all 23 USC schools.

Q OK. But what exactly is the School of Advanced Computing? I still don't get it.
A Let me explain. Operating as a unit of USC Viterbi, the SAC includes the newly renamed Thomas Lord Department of Computer Science, as you suspected. But it features much, much more. It also includes the Ming Hsieh Department of Electrical and Computer Engineering, and the Division of Computing Education,



RISING INTEREST IN COMPUTING, DATA SCIENCE AND AI

Like Johnston and Lourenco, a growing number of USC students with social science, humanities and arts backgrounds are increasingly drawn to computing, data science and AI. As the world enters the so-called Fourth Industrial Revolution — an era of improved efficiencies, productivity and quality driven by artificial intelligence and other technologies — history, philosophy and English majors see the value of becoming technologically conversant as never before.

Reflecting that rising interest among non-engineers, the Technology & Applied Computing Program now features three of USC’s top 10 minors. Applied analytics was the university’s most popular minor, as of October 2023, with more than 500 students. The artificial intelligence applications minor placed seventh, while computer programming ranked 10th. About 80% of TAC students have non-Viterbi backgrounds, said Eric Perez, the program’s associate director of advising and recruitment.

“If we’re going to graduate students who really are informed citizens, they need to be able to understand the data that they’re working with; they need to understand the implications of the algorithms behind what they see,” said Erik Johnson, TAC’s

interim director and USC Viterbi’s vice dean of academic programs. “I think it’s essential for the future of our society.”

Johnson added that digital tools now positively impact fields not typically associated with the sciences. Artists, he said, use generative AI to brainstorm ideas and even produce artworks. Historians leverage AI to translate obscure languages and even to identify topics or themes in old documents. Political consultants analyze the metrics of social media campaigns to determine the demographic makeup of their audience and where to best allocate resources.

“Data has become ubiquitous, and every field is being affected by its availability,” Johnson said.

Added USC Viterbi Dean Yannis C. Yortsos: “Equipping our students, both in STEM and non-STEM disciplines, with the ability to categorize, process and extract meaning from data is an essential aspect of education.”

Against this backdrop, the university recently launched its first new school in more than a decade, the USC School of Advanced Computing, a unit of USC Viterbi. A cornerstone of USC President Carol Folt’s \$1 billion Frontiers of Computing Initiative, SAC will turbocharge the engineering school’s ability to educate students from across campus and across disciplines in the power of advanced computing. It will also bring together engineers, scientists and professionals to leverage computing to address climate change and other major challenges. SAC will appoint 30 new faculty members in priority areas by 2027, and 60 by 2030.

“USC requires all students to complete general education requirements spanning various subjects. It is time to add a computing requirement to that list,” said Gaurav Sukhatme, inaugural director of the School of Advanced Computing and USC Viterbi’s executive vice dean. “Digital competency, which most USC students achieve already, will not do; our graduates need to be digitally fluent.”

Sukhatme added that the SAC will benefit students throughout the university for decades to come. In the realm of AI, the School of Advanced Computing will partner with schools throughout USC to augment all classes in the field.

Similarly, USC Viterbi’s Technology and Applied Computing Program will become even stronger with the hire of several new TAC professors, he added. “Our existing faculty are exceptionally good at mentoring new faculty who we are bringing in to become agents of change.”

ENHANCING DIGITAL SKILLS AND CAREER OPPORTUNITIES

Senior Preston Doll is glad that his minor in AI applications has given him much of that digital fluency. The USC Marshall School of Business major, with a focus in finance, said the combination of business and AI has not only given him invaluable skills to pursue his dream of becoming an investment banker, but it has also made his USC academic journey more fulfilling and complete.

“I think my Marshall education has been great and is providing this broad sort of insight into everything business. I’ve had a chance to explore various fields of interests, from marketing and organizational behavior to economics and finance, which I found my passion in,” said Doll, who landed a prestigious paid internship this summer with Ducera Partners, a New York-based investment bank with an expertise in corporate restructuring. “And learning about AI, especially given how prominent it has become today, just feels like I’ve been able to supercharge that education as a whole. I feel a lot more confident going into the workforce.”

Doll has already put some of that AI knowledge to use. During his junior year, he worked as a contractor for Portrait Analytics, a Boston-based firm that creates generative AI research tools to help financial analysts conduct in-depth investment research quickly, easily and efficiently. At Portrait, Doll said he collected financial data from quarterly and annual reports, among other sources, to train Portrait’s large-language models.

“Had it not been for this combination of the financial and AI acumen, I don’t think I would have been as effective in my role at Portrait, or even landed the position,” he said.

Similarly, Kayla Sarno believes she has greatly benefited from her USC Viterbi classes. A music industry major in the USC Thornton School of Music, the 23-year-old senior decided to minor in the foundations of data science after she realized how much the ability to collect, sift through and analyze data could help her in the music business.

A music marketing executive, Sarno noted, could look at Spotify and Apple Music analytics to see where an artist’s new music is most popular and with what age groups, and then focus marketing dollars there. Additionally, ascertaining an artist’s popularity (or lack

thereof) — based on song streams, video views, and shares and likes on Instagram, TikTok and other platforms — provides important information for booking the right size concert venues in a given market.

On a personal level, Sarno said her growing knowledge of data has helped her flourish academically. In Music Industry 497, a class that explores emerging topics and trends in business and technology in the music and entertainment industries, she and her team had to create a virtual influencer to try to generate as much online engagement as possible. They developed a humanlike character named Ricky Rock and began posting content on Instagram, TikTok and SoundCloud. An analysis of the data showed that Insta was the most popular platform, especially Instagram Reels, or video shorts.

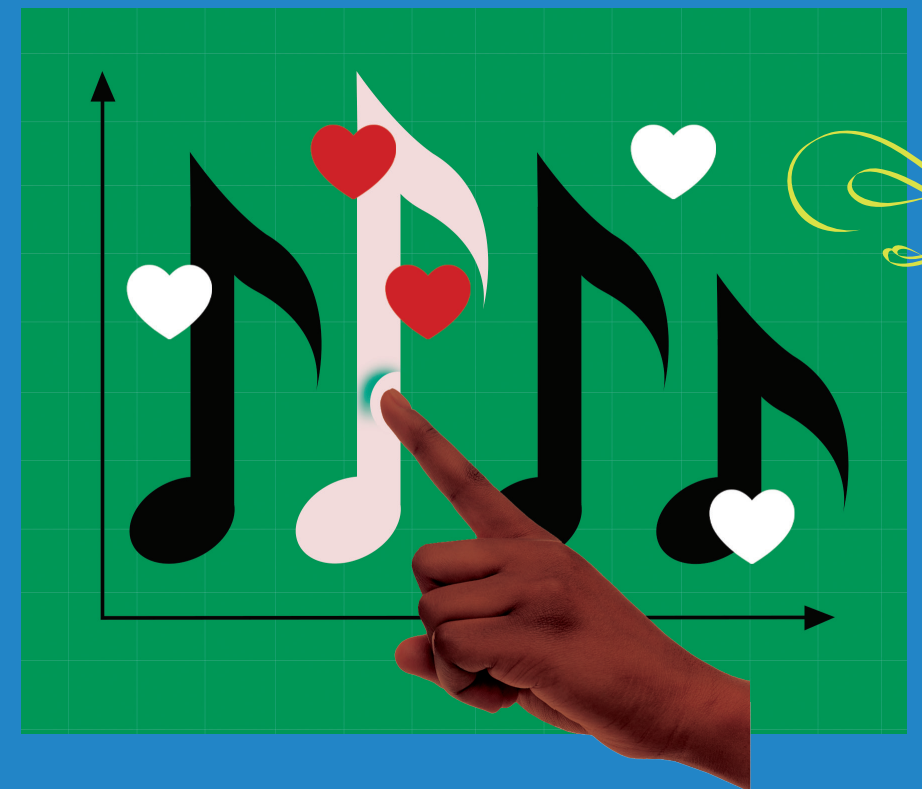
Given that the Reels’ viewers skewed young, Sarno suggested that her team begin targeting teenagers. So, they redesigned Ricky Rock to make the virtual influencer more animated-looking and cooler. The

team also created humorous Reels to appeal to middle school and high school students. The result: Audience engagement rose about 25%.

“I think knowing data science can help me not only in the music industry, but also in a lot of businesses,” said Sarno, who aspires to become a songwriter and artist after graduation. “A lot of people, especially artists, are trying to figure out how to market themselves, where their audience is coming, and how to read data.”

Josh Raghavachary, a 20-year-old psychology major who’s also minoring in foundations of data science, said he has found his TAC data classes so interesting that he now wants to pursue a career in the field.

“With the rise of Internet of Things, where we have our dishwashers and laundry machines all hooked up to the internet, and with the [emergence] of companies like ChatGPT, there’s so much data constantly being generated and collected,” Raghavachary said. “Somebody needs to be able to comb through it, sort it and analyze it. I can definitely see myself being that guy.” ■



which will incorporate the Information Technology Program. Key to the school, also, will be new “faculty affinity groups,” which will ID and build upon faculty across USC in computing plus sustainability, health, arts and humanities, security, social sciences, scientific discovery and quantum, and more.

Q So, in essence, it’s just repackaging a bunch of existing USC Viterbi departments and programs, right?
A Nope. The SAC will strengthen advanced computing at USC by bringing it under one roof and infusing it with major resources. Thirty new SAC faculty members will be appointed in priority areas by 2027, and 60 by 2030. Not only will they enhance educational and research opportunities available to

undergraduate and graduate students, but the additional faculty will also spark innovation by starting new companies and collaborating across academia and industry.

Q I’m looking at a map of USC, but I don’t see the School of Advanced Computing on it. What’s up?

A Good question. The Dr. Allen and Charlotte Ginsburg Human-Centered Computation Hall, a 116,000-square-foot LEED Platinum-certified facility, integrates all of our computer science programs into a seven-story structure. That includes the Thomas Lord Department of Computer Science. Having a world-class facility like Ginsburg Hall allows USC Viterbi to continue attracting the best students and

faculty by creating an environment in which they thrive.

Q I’m a history major interested in the French Revolution and the birth of the modern state. Why should I care about the School of Advanced Computing any more than I do about terabytes and

processors? What does it have to do with me?

A We are living in the most technologically advanced period ever, with exponential changes taking place constantly. In today’s world, being technologically conversant not only matters to STEM majors but also to students of poetry, English and even history. Don’t believe me? Well, USC students in the social

sciences, humanities and arts are being drawn to computing as never before. The Technology and Applied Computing Program, which offers tech courses for non-engineers, now accounts for three of USC’s top 10 minors, with applied analytics coming in at No. 1, artificial intelligence application at No. 7, and computer

programming ranking 10th. The good news: The School of Advanced Computing’s courses are tailored for everyone. ■



The School of Advanced Computing's (SAC) newly formed "Advanced Computing Affinity Groups" leverage interdisciplinary strengths across USC.

ILLUSTRATION BY PAUL COX

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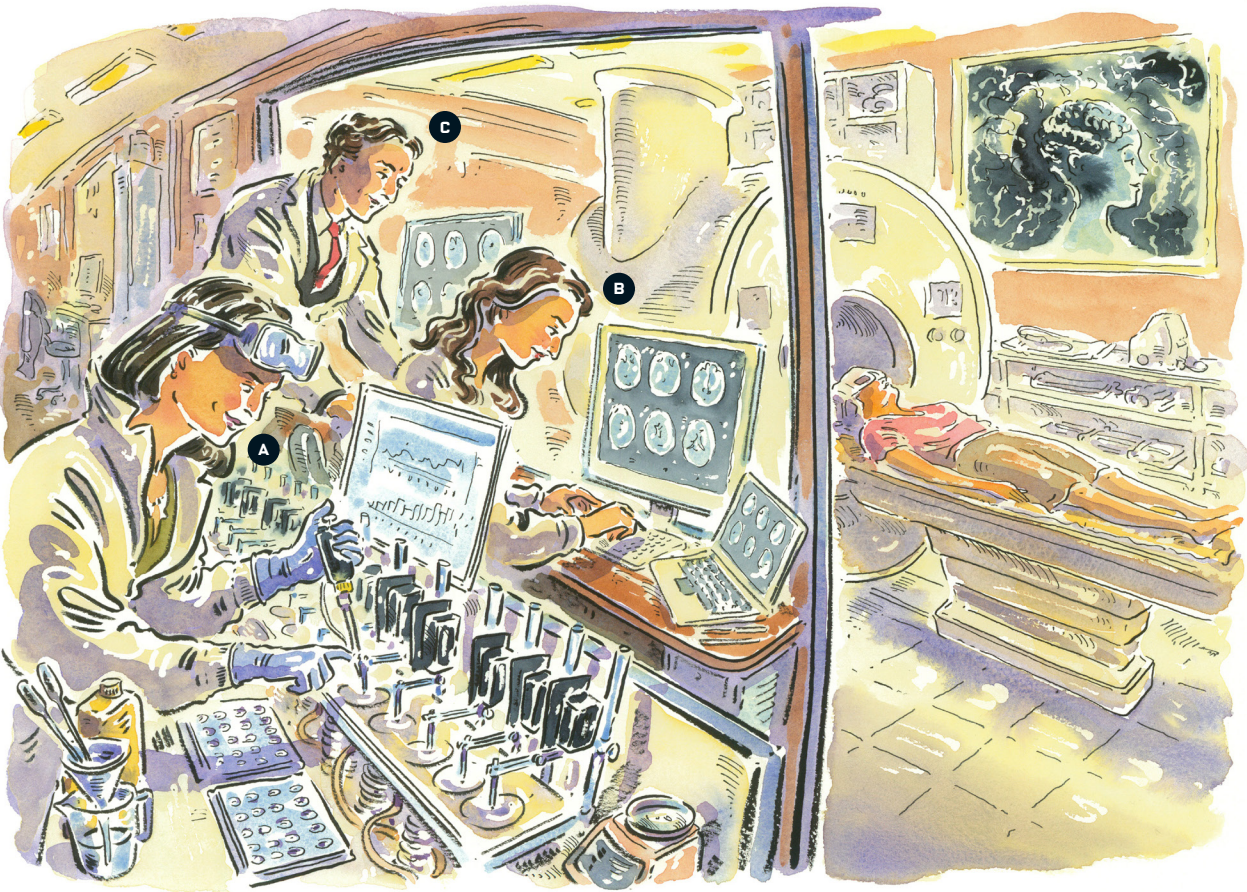
HOW CAN ADVANCED COMPUTING accelerate cures for complex diseases such as Alzheimer's and cancer? What breakthroughs in quantum mechanics will allow us to solve complex problems in medicine, energy and materials science faster than ever before? When tackling society's big challenges — from cybersecurity and climate change to drug discovery and mental health — the whole is undoubtedly greater than the sum of its parts.

That's why the USC School of Advanced Computing (SAC), a unit of the USC Viterbi School of Engineering, is launching "Advanced Computing Affinity Groups," uniting faculty from wide-ranging disciplines across USC's 23 schools, from the arts to social sciences to security to health and medicine.

To support the initiative, a recent \$10 million gift from Andrew Viterbi (see page 54), the pioneering electrical engineer and inventor of the Viterbi algorithm, will fund the hiring of new faculty at these intersections of advanced computing and other academic disciplines. The money will support the recruitment of new distinguished chairs, attracting top-tier faculty talent to catalyze the next big scientific discoveries.

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USC MANN

GAURI RAO

Associate Professor of Clinical Pharmacy and Director of the Quantitative Drug and Disease Modeling Center, Titus Family Department of Clinical Pharmacy

"Computing is essential in all aspects of medicine, starting with drug development. Various computational approaches are used for computer-aided drug design and in silico mechanism-based modeling, from the preclinical to clinical phases. These methods provide better insights into pharmacokinetics (how the body processes the drug) and pharmacodynamics (how the drug affects the body once it reaches its target site), helping to design optimized dosing regimens for translation to the clinic. Next, population modeling using clinical trial data helps us gain insights into interindividual variability in drug exposure and activity, acknowledging that one dose does not fit all."

As a clinically oriented researcher with an engineering background, she has developed a research program focused on addressing antimicrobial resistance (AMR). By integrating in vitro and in vivo infection models with in silico mathematical models, this approach aims to enhance our understanding of the interactions between bacterial pathogens, the host and antibiotic treatments throughout the infection process. Leveraging clinical insights about infections, this systems-based approach has enabled Rao's lab to discover two promising drugs that could significantly aid in combating AMR.

A

USC VITERBI

MARYAM SHANECHI

Professor of Electrical and Computer Engineering, Biomedical Engineering, and Computer Science; Founding Director of the USC Center for Neurotechnology

"In my research, we need to decode internal brain states, such as mood, or behavioral states, such as movements from complex brain signals. Modeling and decoding these complex brain signals require significant innovation in computing to develop novel AI/ML algorithms that can describe these complex signals and extract hidden information from them. This can lead to transformative brain-computer interfaces. We have also modeled the effect of deep brain stimulation on brain activity and mental states by developing new computing algorithms."

Shanechi and her group are developing an entirely new generation of brain-computer interfaces that can transform treatments for diverse brain disorders, such as major depression, which are a leading cause of disability worldwide. They do so by modeling, decoding and regulating abnormal brain activity patterns in these disorders. They have made significant progress by achieving the first decoding of mood from human brain activity, by modeling the effect of brain stimulation therapy on brain activity, and by developing an AI algorithm that can substantially improve the modeling and decoding of diverse brain states.

B

USC KECK

PAUL THOMPSON

Professor of Ophthalmology, Pediatrics, Neurology, Psychiatry and the Behavioral Sciences, Radiology, Biomedical Engineering and Electrical Engineering

"Deep learning methods allow us to predict clinical decline and discover genomic markers associated with Alzheimer's. These AI models are over 90% accurate in detecting Alzheimer's from brain scans, a significant improvement from traditional methods."

In 2019, Thompson and his team focused on identifying potential blood-based markers for early Alzheimer's detection by using machine learning. These methods can analyze vast amounts of neuroimaging data, genetic information and other biomarkers to predict disease progression and identify early signs of Alzheimer's disease with unprecedented accuracy. According to Thompson, one algorithm learned from reviewing more than 85,721 MRI scans from 50,876 patients, while another learned from poring over the 3 billion letters of the human genome to find signs of Alzheimer's.

Thompson is the co-founder and director of the ENIGMA Consortium, a group of over 2,000 researchers in 45 countries dedicated to understanding brain structure and function, based on MRI, DTI, fMRI, genetic data and many patient populations.

C





USC DORNSIFE

NAOMI LEVINEAssociate Professor of Biological Sciences and
Quantitative and Computational Biology

"The oceans play a critical role in making the Earth a habitable planet. Specifically, microscopic organisms in the oceans (marine microbes) play a key role in the global carbon cycle and thus climate. They produce approximately half of all oxygen and act to cycle a pool of carbon that is equivalent to all the CO₂ in the atmosphere. My research focuses on understanding how shifts in climate impact microbial systems and how to identify microbial systems in turn impact climate (ecosystem-to-climate feedback loops)."

"To do this, we develop innovative, interdisciplinary numerical models that provide new insight into how dynamics occurring at the scale of individual microbes impact large-scale ecosystem processes, such as rates of global carbon cycling. This leverages computational representations of cells, ecosystems and the oceans."

She and her team have demonstrated that how individual bacteria interact with each other and organic matter they are degrading can play an important role in setting the transfer of carbon into the deep oceans. They also have shown that environmental fluctuations, driven by ocean physics, drive a trade-off between two evolutionary strategies that determine whether and how fast microbes can adapt to environmental change.

USC DORNSIFE

JULIEN EMILE-GEAY

Professor of Earth Sciences

"Paleoclimatology, the study of past climate, uses archives like corals, tree rings, ice cores, mud from the bottom of lakes or oceans, and cave deposits to reconstruct past climate states. This, in turn, informs the fundamental dynamics of Earth's climate, and informs future predictions, partly through the validation of physics-based models and/or training of AI systems. Because the field is data-driven, work is very time-consuming unless there are efficient workflows that can extract information from these very hard-won datasets, often requiring years of work for a few dozen data points. Computing is therefore essential to this work."

His lab creates software and workflows to analyze, visualize and synthesize paleoclimate datasets, and uses them to constrain the workings of Earth's climate.

He is most known for his work on the climate of the Common Era, and how El Niño-Southern Oscillation has varied in the past and what that means for its future.

USC VITERBI

BARATH RAGHAVAN

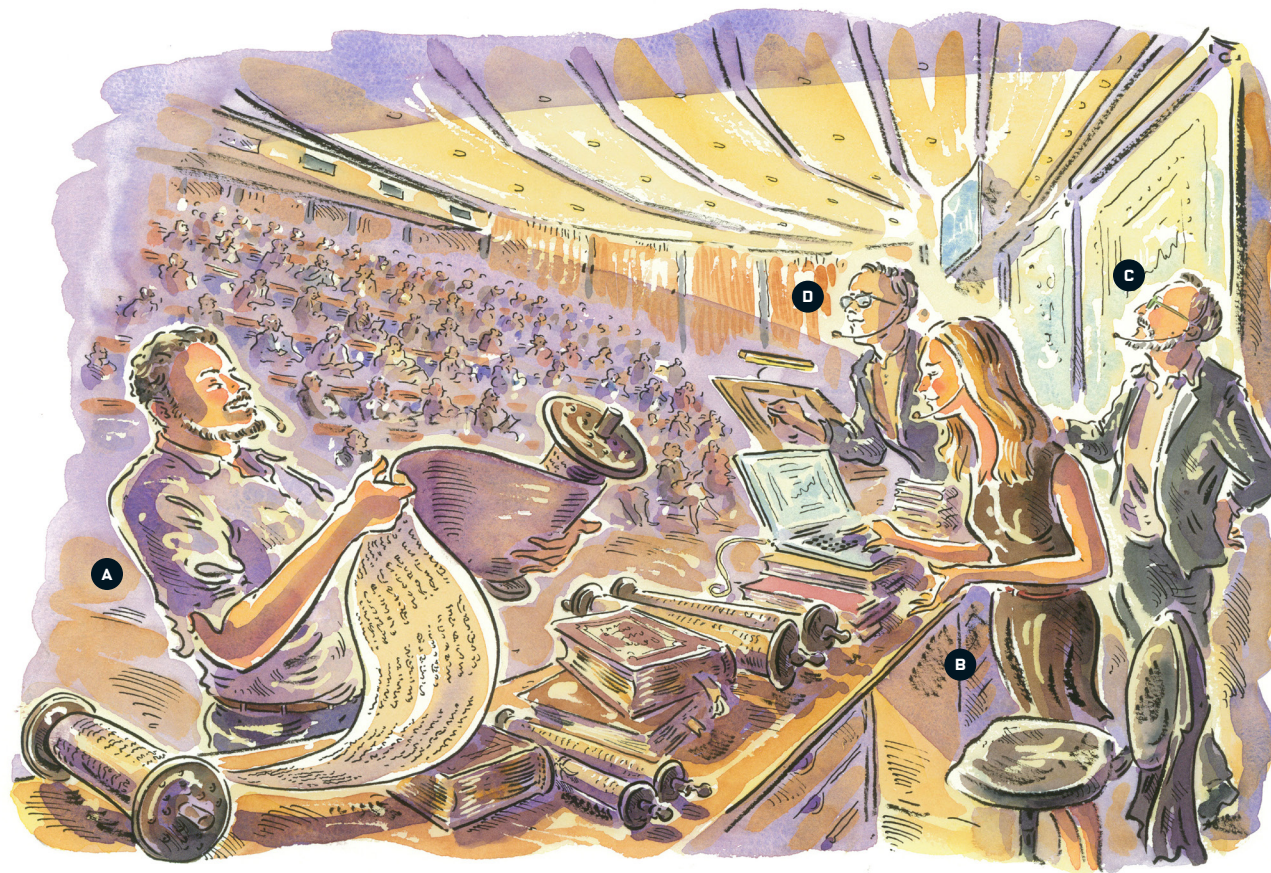
Associate Professor of Computer Science

"As a society, we've turned to computing to solve all the important problems of modern life — sustainability among them. And as computing's ecological footprint grows, it's not only that computing can help address problems in societal sustainability, but making computing itself sustainable is a major challenge."

He has worked on computing for sustainability (using computing to help address problems in agriculture, land use, power grids and more) and sustainable computing (making computing itself more sustainable) for 15 years.

Raghavan's key accomplishments include:

- Performing the first comprehensive study of the total energy use of the internet
- Developing key conceptual frameworks for sustainable computing research, and organizing a workshop on the subject, now in its 10th year
- Developing computational agroecology, which is a new approach to computing-supported sustainable agriculture
- Developing new techniques, such as information batteries, to leverage computing to improve the use of sustainable energy on the grid



USC MARSHALL

**KIMON
DRAKOPOULOS**Associate Professor of Data
Sciences and Operations

"Humanity has evolved for many years, and every disruption has brought replacement of jobs. We had exactly this conversation in the pre-industrial and industrial revolution phase. Sure, change is scary, and humanity has gone through phases of change many times and been successful. I don't see why this would be so different."

Drakopoulos' research focuses on the operations of complex networked systems, social networks, stochastic modeling, game theory and information economics. He views computing through the lens of what it can achieve to improve human health, clarify understanding and solve pressing problems.

With Drakopoulos' urging and assistance, Greek Prime Minister Kyriakos Mitsotakis has increasingly emphasized data science and artificial intelligence. Last year, the prime minister appointed several respected technologists, researchers, academics and policy experts to the country's AI Advisory Committee. Drakopoulos was selected as an appointee.

USC VITERBI

**PHEBE
VAYANOS**Andrew and Erna Viterbi Early
Career Chair and Associate
Professor of Industrial and
Systems Engineering and
Computer Science

"With advances in computing, and by integrating techniques from artificial intelligence (AI) and operations research (OR), we can help address some of the most pressing societal challenges of our time: to help end homelessness, to achieve equal opportunity and justice, to ensure healthy lives and to promote well-being for all."

The USC Center for AI in Society advances knowledge in what "responsible and just AI" is by partnering with community stakeholders, organizations and policymakers. Projects involve interdisciplinary teams of computer scientists working alongside social work researchers to advance AI and OR in a direction that benefits vulnerable communities. One of our major achievements is the design, in partnership with LAHSA (the Los Angeles Homelessness Services Authority), of a tool for matching people experiencing homelessness to the city's very scarce housing resources.

USC DORNSIFE

**KHALIL
ISKAROUS**

Associate Professor of Linguistics

"Understanding how and why AI works as well as it does is essential for attempts at lowering its negative environmental costs. And scientific knowledge in fields like linguistics and psychology on how language works and is used for communication is an essential tool for sorting out what AI actually does."

His work on preserving endangered languages lies at the intersection of linguistics, technology and cultural heritage, using computational models to analyze language patterns and contribute to their survival. Iskarous uses tools from dynamical systems analysis to understand information flows about language inside an LLM. He has also documented LLM-internal knowledge about the working of language.

USC DORNSIFE

**MORTEZA
DEGHANİ**Professor of Psychology
and Computer Science

"AI and social and behavioral sciences have a reciprocal relationship. Many core AI concepts and techniques (like LSTMs and RNNs) have their roots in these sciences. Even today, our understanding of human bias and decision-making informs how we identify and address bias in AI systems."

Conversely, computational tools for modeling, simulation and analysis have revolutionized social and behavioral sciences in the past decade. This two-way exchange will only deepen as computation and AI become more integral to social science research. At the same time, as AI systems become more sophisticated, they'll increasingly need to incorporate insights from the social sciences to ensure they're fair, unbiased and aligned with human values."

His research integrates computing and social/behavioral sciences in two key ways: by incorporating cognitive science findings into NLP [natural language processing] systems and using NLP to uncover psychological processes in social discourse.



USC DORNSIFE

JOHN P. WILSON

Professor of Architecture, Civil & Environmental Engineering, Computer Science, Population and Public Health Sciences, Sociology and Spatial Sciences

"Human security and geospatial intelligence both focus on 'what is where, when,' and this information is used to assess risk and to guide interventions to protect lives and assets around the world."

The digital era has brought a large number and variety of new data sources and streams that can be used to trace the movements of people and assets around the world, and we need spatial analysis and modeling, as well as advanced computing resources, to turn these data into actionable information.

Wilson and his team have launched undergraduate and master's degrees in human security and geospatial intelligence. They propose using advanced computing to support spatial analysis and modeling to pinpoint hot spots that may lead to civil unrest and worse due to the changing climate and the consequences for different regions and nations.

USC GOULD

JONATHAN CHOI

Professor of Law

"Computing is crucial in allowing legal scholars to analyze large bodies of text, like regulatory documents or legal opinions. Because lawmakers produce new legal documents at such a fast pace, computational methods are the only way that we can make large-scale discoveries about trends in the law."

Choi's legal background helps him to identify policy-relevant questions, and computational methods provide the tools to find the right answers. Some of his current research includes evaluating the use of large language models on traditional empirical legal scholarship, demonstrating how to use ChatGPT to analyze legal documents and identifying best practices for the use of large language models in research.

In 2023, in a paper titled "ChatGPT Goes to Law School," Choi and his co-authors found that AI models are rapidly improving, and, in some cases, can outperform real students on law school exam questions.

He has been one of the top 10 most-downloaded legal scholars worldwide. Choi has also won awards and accolades for his research applying computational methods to law. His work has been cited in court opinions and in the popular press by outlets like ABC, CBS, CNN, NBC, The New Yorker and USA Today.

USC VITERBI + ANNENBERG

EMILIO FERRARA

Professor of Computer Science and Communication

"Computing is essential to the field of security because it enables the development of advanced algorithms and systems capable of detecting, analyzing and mitigating threats in real time. It also allows for the integration of machine learning, data mining and artificial intelligence to predict and counteract sophisticated cyberattacks and information manipulation at scale."

Ferrara has integrated computing with security by pioneering the use of graph-based models and machine learning to uncover information operations, such as disinformation campaigns and online manipulation. Notable accomplishments include his work on identifying botnets in social media ecosystems and developing methods to protect online information integrity, particularly in the context of elections and public discourse.

During the 2016 presidential election cycle, Ferrara's analysis showed how automated bots were shaping political debates on social media — research that was later cited in federal investigations into Russian interference in that election.



USC VITERBI

KRISHNA GARIKapati

Professor of Aerospace and Mechanical Engineering

"Computing is fundamental to making discoveries in much of the physical sciences. Certainly, this is true of biophysics and materials physics, which are disciplines that interest me."

There are mathematical descriptions underpinning these fields that have a generality stretching far beyond a specific phenomenon. As an example, the dynamics governing the migration, proliferation and transition to cancerous behavior of cells are shared by swarms of animals, populations of humans and communities, and even the way opinions form and spread through society. Their mathematical complexity means that computation is often the only way to tease out the emergent phenomena in these systems. In turn, physics inspires the design of his computational methods.

Using computational and scientific machine learning methods, he and his team have discovered that when cells with cancerous potential are signaled to by certain non-cancerous stromal cells, they can organize themselves, forming patterns and transitioning to an aggressive, rapidly migrating and proliferating behavior. Yet wound healing by the same cancer cells happens mainly by their going on a disorganized, random walk. These results have important implications for understanding how tumors metastasize and spread to distant organs.

USC DORNSIFE

ANNA KRYLOV

USC Associates Chair in Natural Sciences and Professor of Chemistry

"In chemistry and physics, computing is an integral part of research. Quantum chemistry calculations connect experimental observations with a detailed atomistic picture of underlying processes. Such calculations are essential for deriving insight and advancing our understanding of molecules and materials."

Krylov is developing new quantum chemistry approaches and computer codes for the description of electronically excited and open-shell species, including electronically metastable states. These methods are implemented in the Q-Chem software package, which is one of the leading codes for molecular simulations. Her group is also using these computer codes to investigate the role of radicals and electronically excited species in combustion, solar energy, bioimaging, spectroscopy and quantum information science.

Her important accomplishments include: development of spin-flip approach to strong correlation and extending coupled-cluster theory to spectroscopy modeling in high-energy and high-intensity regimes.

USC DORNSIFE

VSEVOLOD "SEVA" KATRITCH

Professor of Quantitative and Computational Biology, Chemistry and Pharmacology and Pharmaceutical Sciences

"My field of research concerns biochemistry and structural biology and their applications to the discovery of new therapeutic drugs. Computing, both physics-based molecular modeling and data-driven deep learning/AI, is the key to modern drug discovery, dramatically reducing its time and cost requirements and improving resulting therapies."

His lab is purely computational and works in close collaboration with experimental labs that test his team's predictions. Most notably, Katritch's group has developed V-SYNTHES — a new computational approach to screening chemical spaces of billions of compounds for new drug candidates. This technology, now with a deep learning accelerator module, has become a core platform for the CNT3D center, where his team collaborates across USC and around the globe to facilitate early drug discovery for clinically relevant targets.





USC CINEMA

MARIANTINA GOTSIS

Professor of Cinematic Practice at Interactive Media & Games and Media Arts + Practice

"Computing research generates essential tools and methods for creating, imagining, storing, distributing, viewing, listening, feeling, thinking, sharing, archiving, processing, analyzing and collaborating to help us dissolve borders between disciplines and geographies. While I am a fine artist by training, my advanced computing skills are what enable me to cross sectors."

Gotsis, who runs the USC Creative Media & Behavioral Health Center, uses off-the-shelf technologies, such as game engines, VR headsets and body sensors, but also experiments with emerging technologies, such as generative AI, neurotechnologies and wearables.

She and her interdisciplinary collaborators have done pioneering research in mobile health games with the USC Wellness Partners study — one of the first socially networked "gamification" exercise interventions — before the proliferation of social media and smartphones and several "exergames" for sensorimotor rehabilitation for patients, including "Skyfarer" for spinal cord injury and "Wordplay" for Parkinson's. Both exercise games have been evaluated by physical therapists and patients, who found them to be motivating and helpful. The CMBHC-affiliated teams also used stereoscopy and extended reality technologies to develop educational experiences for children and families, teaching about vision health ("Enchanted Garden") and nutrition ("Virtual Spouts").

USC ARCHITECTURE

ALEXANDER ROBINSON

Associate Professor, Landscape Architecture Program and Urbanism Program

"In my work on nature-based landscape infrastructure, computing is a fundamental tool for understanding, communicating and ultimately designing these complex landscapes. I employ it extensively for community outreach, field studies and hydraulic modeling on the Los Angeles River."

Robinson's research currently focuses on the Los Angeles River, which he has studied since working on the award-winning Los Angeles River Revitalization Master Plan. At the Inclusive Infrastructure Design Lab, he collaborates with faculty in the USC Viterbi School of Engineering (Mitul Luhar and Gale Lucas), USC Cinematic Arts (Andreas Kratky) and USC Dornsife Public Exchange, as well as the City of Los Angeles Bureau of Engineering and the United States Army Corps of Engineers. Recently, they presented a 60-foot-long model of the river's flow that demonstrated different scenarios of potential flooding and how these floods would affect the L.A. environment, including people experiencing homelessness.

Furthermore, they are using computing to conduct frequent analytical field studies, largely with drones. With a closer understanding of the rapidly evolving urban environment, they open the door to more nature-based solutions. Finally, they also employ USC-developed real-time, numerical modeling to accelerate the design process.

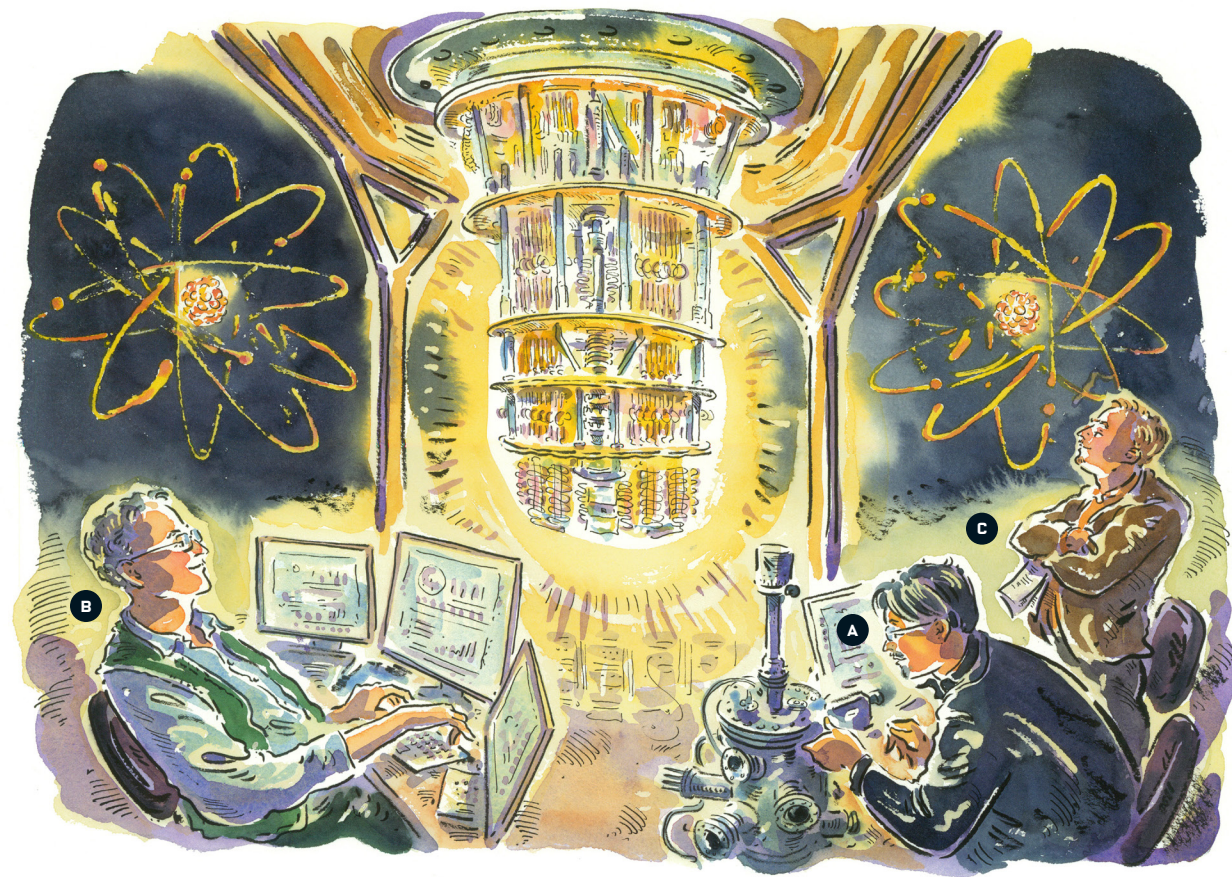
USC DORNSIFE

ALEXIS WELLWOOD

Professor of Philosophy, Linguistics and Psychology

"With the incredible advances in linguistic ability demonstrated by generative AIs, foundational research into the nature of human language is more important than ever. To what degree are human beings similar to computers, and in what ways are we different? I study human language as a cognitive capacity through the lens of formal semantics, a discipline with roots in philosophical logic and the foundations of computer science. Computational concepts like abstraction and the composition of functions are utterly critical to properly characterizing linguistic states and processes. In the Dornsife Meaning Lab which I direct, we conduct online experiments with children and adults using state-of-the-art computational methods to analyze and model the data."

How natural languages "package" meaning can look very different across languages, but Wellwood's research has provided strong, convergent evidence that this variation masks significant and fundamental similarities. She has shown that the same highly specific patterning in adult understanding of the word "more" and its cognates across languages, like "más" in Spanish or "plus" in French, is already grasped by children just entering preschool. This work, geared toward helping us formalize the properties of distinctively human thought, is receiving increasing interdisciplinary recognition across philosophy, linguistics and cognitive psychology.



USC DORNSIFE

SUSUMU TAKAHASHI

Associate Professor of Chemistry and Physics and Astronomy

"The foundation of quantum computing is the key to various quantum information technologies."

His research uses the basics of quantum computing for high-sensitivity physical measurements. In 2011, using high-magnetic fields, Takahashi and his colleagues managed to suppress decoherence, one of the key stumbling blocks in quantum computing. Decoherence has been described as a "quantum bug" that destroys fundamental properties that quantum computers would rely on.

His team has improved the sensitivity of the magnetic resonance spectroscopy to the level of a single molecule using quantum sensing technology. Takahashi's interdisciplinary experimental research group overlaps in the areas of physical chemistry, quantum information science and condensed matter physics.

A former Hitachi semiconductor engineer, Takahashi now collaborates with Trojan engineers like USC Viterbi's Stephen Cronin. They recently received the Zumberge Preliminary Studies Research Award for "Development of Bright and Stable Diamond Quantum Emitters for Quantum Sensing Applications."

USC VITERBI

DANIEL LIDAR

Viterbi Professorship in Engineering and Professor of Electrical and Computer Engineering, Chemistry and Physics and Astronomy

"Quantum computers have the potential to solve problems that are currently impossible for classical computers, like simulating complex chemical reactions or breaking modern cryptographic codes."

A variety of factors can cause errors, or noise, including heat, the presence of magnetic fields or imperfections in hardware. Making quantum computers faster and better able to solve increasingly complex problems requires advanced noise suppression. One way to achieve this is encoding information in a single qubit (a unit of information in quantum computing) across multiple physical qubits. This achieves redundancy, so if an error occurs, it can be detected and fixed without the original information being lost. The same principle applies to telecommunications.

Lidar and other researchers are pushing the known boundaries on demonstrating the ability of quantum computers to speed up calculations. For example, in 2023, he and his former graduate student Bibek Pokharel, currently a research scientist at IBM Quantum, demonstrated the first unequivocal algorithmic quantum speedup advantage. Using a 27-qubit IBM Montreal Quantum chip, and with the help of error-suppression methods they developed, they showed that the quantum computer could win a "Jeopardy!"-like game: it correctly guessed secret strings of bits faster than the most efficient classical computing algorithm, with an advantage that became more pronounced the longer the bitstring was.

USC DORNSIFE

STEPHAN HAAS

Professor of Physics and Astronomy

"Computing is essential to the fields of quantum science and engineering because understanding quantum phenomena requires the modeling of complex, interacting particles in quantum systems, such as electrons in superconductors. These models are often highly intricate, and their properties can typically only be uncovered through advanced computational methods, such as Quantum Monte Carlo. Additionally, emerging quantum computing technology enables us to simulate dynamic processes in interacting quantum systems. For instance, at our Quantum Innovation Center, we utilize the IBM quantum computer to explore these processes."

His group integrates computing with quantum science by employing advanced techniques like renormalization group, Quantum Monte Carlo, and exact diagonalization to investigate many-body systems in fields such as quantum magnetism and superconductivity. Notable accomplishments include applying the Stochastic Series Expansion Method to study quantum spin liquids and developing optimization algorithms for nanoscale optoelectronic devices. Haas' team also explores quantum dynamics and topological systems, contributing to the understanding of noise-assisted tunneling and hybrid topological phases. ■

EL ROBOTED

Meet some of the members of the USC robot class of 2024-25. Be sure to leave some space in the margins for others to sign.

BY GREG HARDESTY

ILLUSTRATION BY MARCELO BAEZ



eady to meet some characters — specifically, some computer-activated coeds? Silicon-based seniors?

Bionic beauties with a lot more retrievable memories about college than you have? In this yearbook-inspired feature, we highlight 28 robots you might encounter in the labs, hallways or even outdoor spaces of the new USC School of Advanced Computing. As Maja Matarić, the Chan Soon-Shiong Chair and Distinguished Professor of Computer Science, Neuroscience and Pediatrics, notes: The school's robots span a remarkably broad range of research. So, acquaint yourself with them before they ditch class for some downtime at the Cyber Cafeteria.

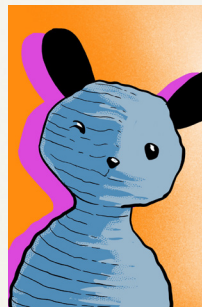


"Man, you really love those dull, repetitive tasks! I'll let you know the next time I need to transport tools or tend to a 3D printer at 3 am."



Although you're made of 3D printed parts, you have real heart. I love how you act as a study companion to college students with ADHD. You're a real giver!

P.S. Love your knitted aesthetic!



Blossom

MOST LIKELY TO be your "zen" robot buddy (for only \$250!)

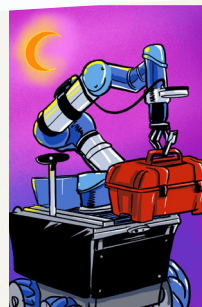
HOMEROOM Interaction Lab (Prof. Maja Matarić)



LoCoBot

QUOTE "You want me to go to the refrigerator and fetch the salmon? I'm on it!"

HOMEROOM GLAMOR Lab (Prof. Jesse Thomason)



ADAMMS

(Agile Dexterous Autonomous Mobile Manipulation System)

DREAM JOB Working in a factory

HOMEROOM USC Center for Advanced Manufacturing (CAM) (Prof. S.K. Gupta)

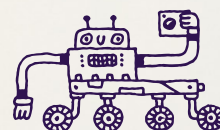


LayupWizard

The LeBron James of prepreg composite layups in manufacturing

HOMEROOM USC Center for Advanced Manufacturing (CAM) (Prof. S.K. Gupta)

NOTHING BUT LOVE AND RESPECT FOR A MOBILE ROBOT LIKE YOU WHO RESPONDS AS WELL AS YOU DO TO LANGUAGE COMMANDS ABOUT WHERE TO GO NEXT. SIRI SHOULD ONLY BE SO COOPERATIVE!

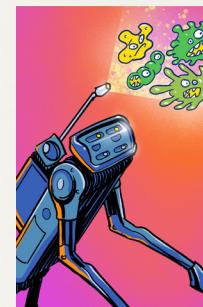


KEEP GOING

Just like the mighty warrior of Troy, you're tougher than you look! You can lift more than half your body weight. You've got a sick 16-inch vertical. And you're the only robot I know who wears tennis shoes.

DON'T STOP

DIVVIE! YOU WERE SO LUTCH DURING THE PANDEMIC. I REMEMBER ALL THE CLASSROOMS YOU DISINFECTED DURING COVID. IS IT TRUE YOU CAN SEE HOW CLEAN SURFACES ARE BETTER THAN A HUMAN?

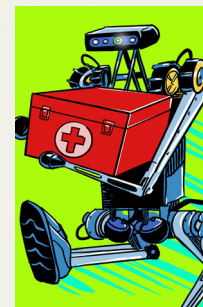


LASER-D

(Legged Agile Smart Efficient Robot for Disinfection)

"The robot dog that fights germs!"

HOMEROOM Dynamic Robotics and Control Laboratory (CAM) (Prof. Quan Nguyen)



HECTOR

(Humanoid for Enhanced Control and Open-Source Research)

MOST LIKELY TO be a first responder in a disaster

HOMEROOM Dynamic Robotics and Control Laboratory (CAM) (Prof. Quan Nguyen)



FALL-E

MOST LIKELY TO knock people off balance

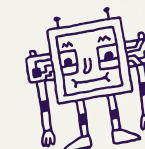
HOMEROOM HaRVI Lab (Prof. Heather Culbertson)



Traveler

MOST LIKELY TO act like a scientist (measuring loose soil and rocks) in deserts, mountains and forests

HOMEROOM RoboLAND Lab (Prof. Feifei Qian)



So cool they named you after the USC mascot. Can you carry me on your back during football games?

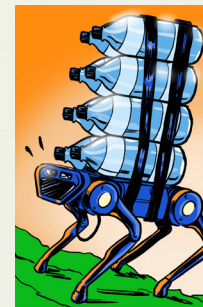
ROBOTS



Spirit

MOST LIKELY TO walk on the moon or Mars

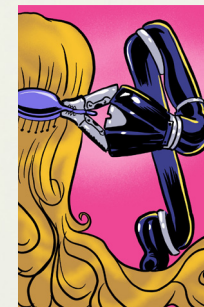
HOMEROOM RoboLAND Lab (Prof. Feifei Qian)



Unitree A1

MOST LIKELY TO carry heavy loads (even in treacherous and hazardous environments)

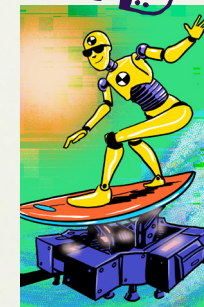
HOMEROOM Dynamic Robotics and Control Laboratory (CAM) (Prof. Quan Nguyen)



CARA

"Best friends with Rapunzel"

HOMEROOM ICAROS Lab (Prof. Stefanos Nikolaidis)



WaveRider

MOST LIKELY TO use VR surf therapy to help people with chronic pain

HOMEROOM HaRVI Lab (Prof. Heather Culbertson)

Hey, Spirit! What's it like working for NASA? Heard you walked the Mount Hood glacier in Oregon, the White Sands desert in New Mexico. Even SoCal beaches. Send me a postcard!!

Sorry you didn't make it to the NBA draft! But you're a great worker with an uncanny attention to details!

Remember that time it was SO hot outside, and you brought us all bottled waters? You carried 92% of your body weight on your back — never complained!

DEAR CARA, I THINK IT'S AWESOME THAT YOU HELP PEOPLE WITH LIMITED MOBILITY, INCLUDING STROKE SURVIVORS, COMB THEIR HAIR. BUT WHAT CAN YOU DO FOR A BALD BOT LIKE ME?

So just wondering... can you use all your tiny drones to create a 3D bouquet of flowers that looks, feels and smells real? I kinda forgot my anniversary...

SMILE

You think you're so great! If I had five cameras and Velodyne sensor on my head, maybe I could map the entire USC campus, too.

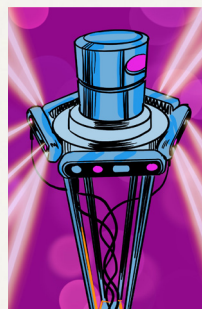
ROBOT

For a big industrial robot, you're surprisingly gentle! And that's great, since you're a collaborative robot, not an industrial one.



HEARD YOU STAY UNDERWATER UP TO 10 HOURS AT A TIME! THANKS FOR PROTECTING OUR OCEANS FROM CRAZY ALGAE BLOOMS!!

DRIP



Beobot the Third

MOST LIKELY TO map the world (in 3D)

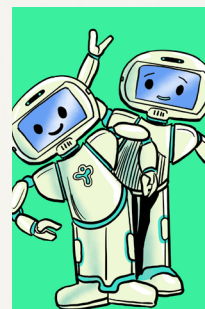
HOMEROOM USC iLab (Prof. Laurent Itti)



Flying Light Specks

MOST LIKELY TO create the "Star Trek" holodeck

HOMEROOM FLS Lab (Prof. Shabram Ghandeharizadeh)



QTrobot

MOST LIKELY TO help kids with autism and cerebral palsy

HOMEROOM USC Interaction Lab (Prof. Maja Mataric)

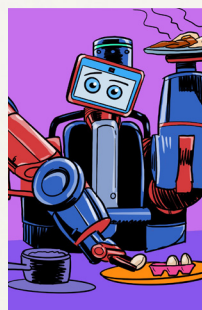


Quori

VOTED "Best dressed"

HOMEROOM USC Interaction Lab (Prof. Maja Mataric)

HEY QUORI, YOU LOOK GOOD IN WHATEVER YOU WEAR! SO COOL THAT YOU WERE IN A STUDY THAT SHOWED HOW DIFFERENT CLOTHES CAN AFFECT PEOPLE'S EXPECTATIONS OF A ROBOT. WHO CARES IF (-3PO IS NUDE??



Baxter

MOST LIKELY TO make you breakfast or tie-dye your shirt

HOMEROOM USC Center for Advanced Manufacturing (CAM) (Prof. S.K. Gupta)



EcoMapper

MOST LIKELY TO be a marine biologist (or the next Magellan)

HOMEROOM USC Robotic Embedded Systems Lab (Prof. Gaurav Sukhatme)



RESL Quadrotor

"A small bot with a big brain!"

HOMEROOM USC Robotic Embedded Systems Lab (Prof. Gaurav Sukhatme)



Husky

QUOTE "Anyone feeling like off-roading this weekend?"

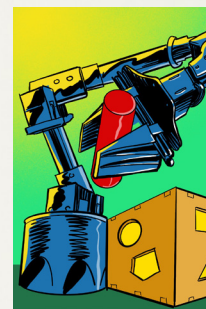
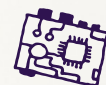
HOMEROOM USC Center for Advanced Manufacturing (CAM) (Prof. S.K. Gupta)

Remember that time we got stuck in the mud? Nope, me neither, thanks to your powerful 4x4 zero-maintenance drivetrain!

When you're only 26 inches tall, it helps to stand out! P.S. Can you teach me how to dance the Twist, Thriller and Whip/Nae Nae?



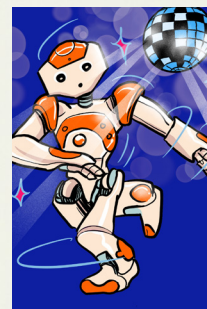
Sure, you can put a square peg into a square hole. But can you make me breakfast?



WidowX

MOST LIKELY TO have 3D-printed, custom "gripper" hands

HOMEROOM Learning and Interactive Robot Autonomy Lab (LiraLab, Prof. Erdem Biyik)



Nao

VOTED "most expressive in class!"

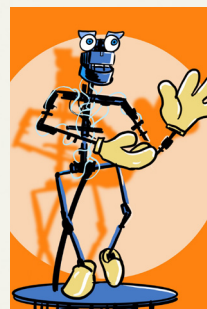
HOMEROOM USC Interaction Lab (Prof. Maja Mataric)



Kuri

MOST LIKELY TO "Explore the moon with you in mixed reality."

HOMEROOM USC Interaction Lab (Prof. Maja Mataric)



Sparky

QUOTE "I stole Mickey's gloves when I left Walt Disney Imagineering."

HOMEROOM USC Interaction Lab (Prof. Maja Mataric)

FEATURES

IT WAS SO COOL PUTTING ON A PAIR OF GLASSES AND SEEING THE SAME CRAZY AUGMENTED WORLDS TOGETHER!

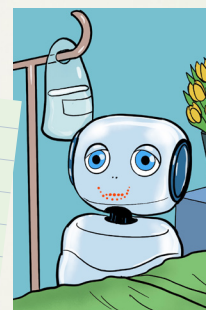


You would be such a great tour guide for our lab! After that, maybe Jungle Cruise at Disneyland?

Love

You love folding and drying towels, and you've got cute panda colors - will you MARRY me?

You're like a smaller version of Baymax from "Big Hero Six"! CHLA is lucky to have you!



Maki

SUPERPOWER Calming anxious kids right before a surgery or IV

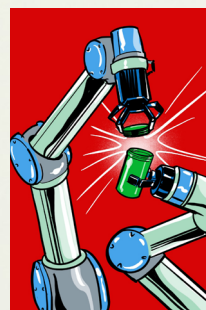
HOMEROOM USC Interaction Lab (Prof. Maja Mataric)



Sci-Fi Bot

MOST LIKELY TO blend in with real fish (in the name of science)

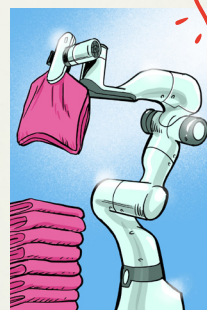
HOMEROOM USC Center for Advanced Manufacturing (CAM) (Prof. S.K. Gupta)



Duplo

"When one robot arm just won't do."

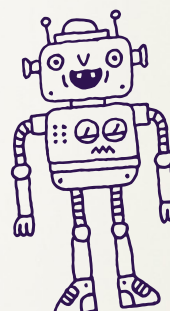
HOMEROOM USC Robotic Embedded Systems Lab (Prof. Gaurav Sukhatme) / SLURM Lab (Prof. Daniel Seita)



Panda

MOST LIKELY TO do laundry for you!

HOMEROOM USC Robotic Embedded Systems Lab (Prof. Gaurav Sukhatme)



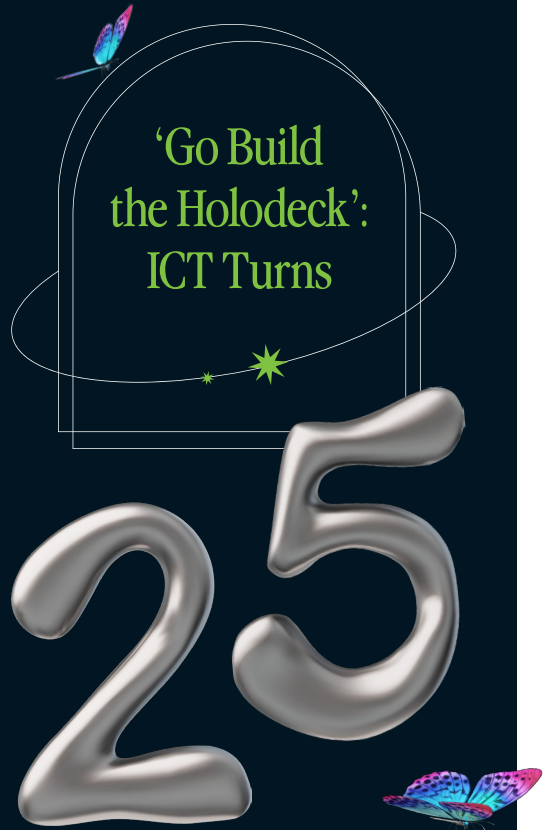
Dude... I just realized your name is short for Sarasa Comet Inspired Fish Robot.



Hey, Duplo, next time I need a jar opened or an item placed in a drawer, you've got the UR5 arms for the job!



RESL Quadrotor, my main man, it's amazing that a bot as small as you can carry out such complicated and time-consuming computational and sensory tasks. You brainiac!



BY RANDALL W. HILL, JR.

ILLUSTRATION BY MACIEJ FROLOW



The executive director of the USC Institute for Creative Technologies looks back at 25 years of digital marvels and toward an even brighter future.

Editor's Note

The USC Institute for Creative Technologies, a unit of USC Viterbi, celebrated its 25th anniversary in August 2024. Randall Hill, ICT executive director; vice dean, USC Viterbi School of Engineering; and Omar B. Milligan Professor in Computer Science (Games and Interactive Media); shares ICT's origin story (and its connection to "Star Trek") and looks ahead into the research that will power its future.



Twenty-five years ago, the USC Institute for Creative Technologies (ICT) was born out of the U.S. Army's desire to create the "Star Trek" holodeck. Through both basic and applied research, ICT has done exactly that: creating virtual environments in animation and sound, photo-real computer graphics and intelligent agents.



In 1996, an extraordinary workshop took place about 40 miles south of Los Angeles, in Irvine. It was called "Modeling and Simulation: Linking Entertainment and Defense" and had been set up by the National Research Council. About 60 people had been invited. Half the room was from the entertainment industry. Everyone else was from across academia and the branches of the Department of Defense.

Why had the National Research Council brought everyone together? Well, the Department of Defense (DOD) had been watching the emergence of immersive and interactive entertainment for some time and wondered how they could take advantage of those skills for the military.

Back in Orange County, the presentations sparked something. The conversation grew animated as participants found common ground. Much of that connection was born from science fiction that had become science fact. It certainly didn't hurt that many of the military participants were die-hard Trekkies, and several of the Hollywood folks in the room were from Paramount Studios and had worked on the famed 1960s TV classic.

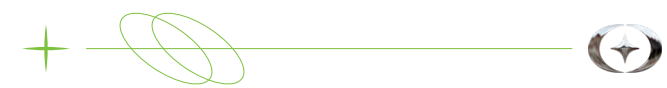
After the event, the NRC produced a set of academic papers, later published as a book. It could have ended at that, but it didn't.

People with influence on both sides wanted to make sure something came out of it. Anita Jones, the U.S. Department of Defense's director of defense research and engineering from 1993 to 1997, and Mike Andrews, the Army's then-chief scientist, decided to form a university-affiliated research center, known as a UARC. The proposed UARC would provide unique core competencies in the areas of realism, simulation, the behaviors within simulations, and the application of simulation technology into education, training and operations. USC won the competition for the UARC, which was named the Institute for Creative Technologies, or ICT.

USC decided to locate the fledgling institute off campus in Marina del Rey. Hollywood production designer Herman F. Zimmerman, renowned for his futuristic-looking sets on "Star Trek," got to work, creating highly imaginative interiors for ICT. It resembled the inside of a starship, complete with bulkheads and an automatic

door in the front of the building that opened with a "whoosh." The legend goes that Zimmerman had his crew mock up and construct everything on a Paramount soundstage before they eventually installed the ICT interiors over the course of a weekend.

ICT's first staffers came from Disney, Paramount, across USC, and other academic institutions. It was both a visionary and highly experimental group of talented individuals. Everyone had big ideas, and there were several grand plans. The DOD's official mandate was to make military training better by creating immersive systems to improve decision-making, build better leaders and support the acquisition of other foundational skills.



Building the holodeck

But our Army sponsors knew exactly what they wanted. They said our mission, if we chose to accept it, was: "Go build the holodeck." A few years later they might have said, "Go create the OASIS [Ontologically Anthropocentric Sensory Immersive Simulation] from 'Ready Player One.'"

Twenty-five years later, that's exactly what ICT has done. ICT creates highly realistic computer graphics and virtual environments, delivering synthetic and adaptive experiences, which are so compelling that participants respond as if they were real.

Today, ICT has 16 labs, with academics working alongside creatives and makers. We build concepts, demos and prototypes that are cost-effective, agile and adaptive.

Some of ICT's best-known projects include advanced head-mounted displays (HMDs), digital-based human performance apps, dynamic adaptive synthetic characters, virtual reality-based exposure therapy for veterans, simulations to improve interpersonal skills, counter-terrorism strategy games, virtual human therapeutics, ship simulators and AI-powered digital doppelgangers inside our Light Stage.

Along the way, ICT has received two Academy Awards (Science and Technology) for innovations that have been used in more than 50 Hollywood movies, including "Avatar" and "Blade Runner 2049." Many ICT

FEATURES

projects have become DOD programs of record, part of the formal acquisition program that has been approved and authorized by the appropriate level of authority within the DOD. They include DisasterSim, a game-based training tool focused on international disaster relief; Emergent Leader Immersive Training Environment (ELITE), an instructional platform, delivered via digital devices, that provides opportunities to practice skills in realistic and relevant training scenarios with virtual human role-players and real-time data-tracking tools that allow for structured feedback; and One World Terrain (OWT), an Army program designed to assist the DOD in creating the most realistic, accurate and informative representations of the physical and nonphysical environment.



The next 25 years

In 2023, the USC Institute for Creative Technologies (ICT) became part of the USC Viterbi School of Engineering. The institute now sits alongside its sister institute, the USC Information Services Institute (ISI), within the USC School of Advanced Computing, a proud part of USC President Carol Folt's \$1 billion Frontiers of Computing initiative.

Here are three initiatives that will form the core of our work in the next 25 years and beyond.



Next-gen education

AI has changed education forever. Knowledge is no longer learned by rote, or even valued in the same way it once was. Everything we need to know is at our fingertips, and its delivery is mediated by AI-powered assistants. Education is now moving toward learning how to verify incoming information, interpreting data, comprehending the value of concepts, upskilling to maintain relevance and developing successful collaboration within human-AI teams.

ICT's Learning Sciences Lab is a pioneer in this area via its Personal Assistant for Life-Long Learning (PAL3), a friendly, informative and humorous virtual agent that is personalized to students and can be accessed from mobile devices. Simply put, PAL3 is your very own AI, which supports lifelong learning, including on-the-job and just-in-time training, as well as ongoing assessment and tracking. PAL3 tracks where learners are (knowledge, past training and experience) and where they want to go (career and learning goals), and uses that information to give personalized, adaptive coaching and resource recommendations to build a more resilient workforce.

Building on its success with PAL3, ICT is leading AIRCOEE (AI Research Center of

Excellence for Education), a two-year, \$4.5 million dollar research contract through U.S. Army Combat Capabilities Development Command, in collaboration with the USC Rossier School of Education and ISI. AIRCOEE is addressing two fundamental questions through building a suite of tools: "How do we use AI to improve education?" and "How do we upskill our population in AI and prepare them for the jobs of the 21st century?"



Future of filmmaking

As part of its basic and applied research to advance technologies for automated storytelling and narrative understanding, ICT's Narrative Group Lab is now investigating how AI will change the future of filmmaking.

Can a small group of independent filmmakers on a budget rival the digital sorcery of films like "Avatar: The Way of Water"?

Our project "Acting and Interacting in Generated Worlds" is examining how to integrate AI into production workflows, by capturing the real-world performances of professional actors for playback in fully synthetic (computer-generated) environments.

This research moves us beyond current virtual production setups with actors performing on controlled light stages featuring LED volume walls. Instead, our research will allow actors' performances to be captured in any lighting environment. Then we can retarget their work onto digital doubles, inside computer-generated digital worlds. This will enable us to achieve Hollywood-quality productions, with small teams of filmmakers able to create movies that rival those with much larger production crews.



Saving planet Earth

Finally, ICT's geospatial terrain research could help save our planet. Earlier this year, I was invited to England to meet with the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), located at Cambridge University in England.

The U.N. group is very interested in our data capture (using drones), 3D processing and semantic segmentation (computer vision for accurate labeling) to produce high-resolution terrains. This could assist with monitoring and assessing the biodiversity of the planet. We hope to partner with the United Nations on this worthwhile project, providing our AI tools to improve their Protected Planet database.

We can then take action where it is needed, and protect the world we live in. ■

Learn more about ICT at: ict.usc.edu



TROJAN TRIO MAKE WAVES AT GOOGLE DEEPMIND

USC computer science alumni worked on Google's 'first-of-its-kind' robot AI model, the **Robotic Transformer 2 (RT-2)**.

BY CAITLIN DAWSON

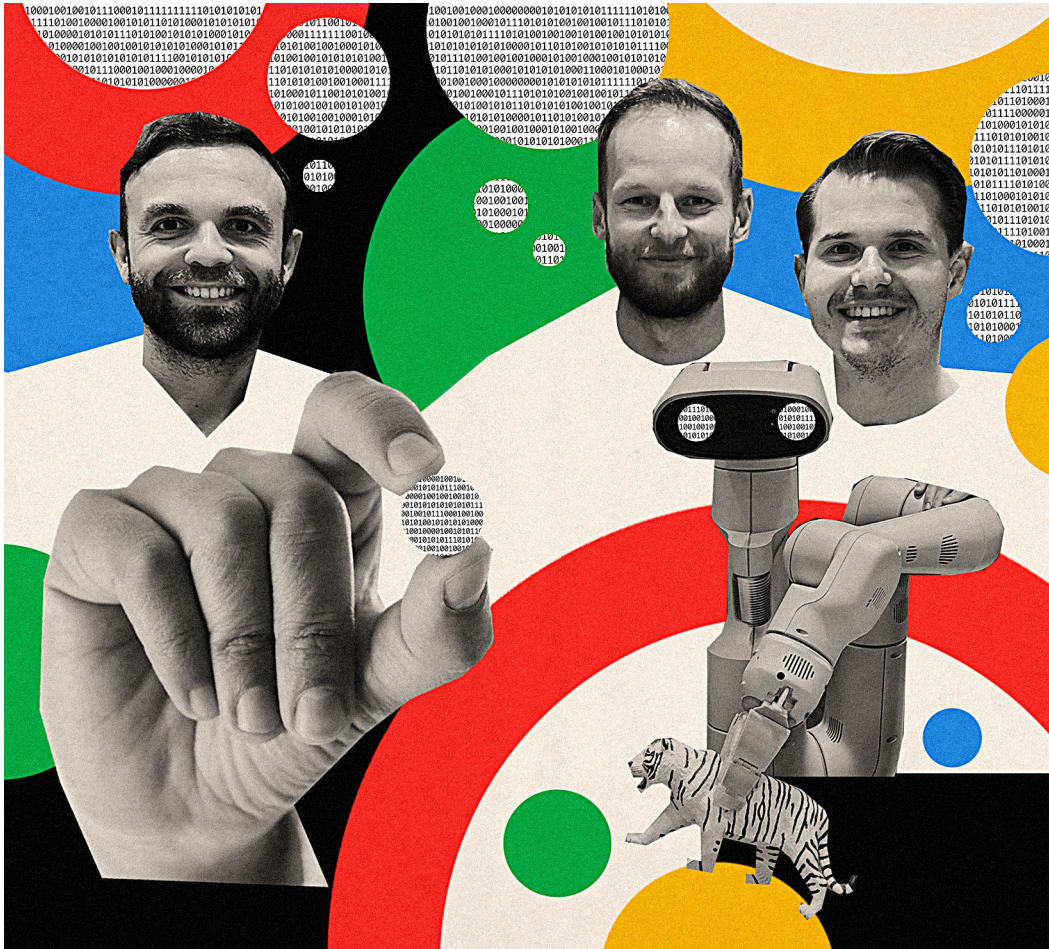
ILLUSTRATION BY LINCOLN AGNEW

BEHIND EVERY GOOD ROBOT is a human with serious smarts, a big imagination and a penchant for problem-solving. Or, in the case of Google DeepMind's Robotic Transformer 2 (or RT-2), a team of humans — including three recent USC computer science doctoral graduates.

"In movies and TV, successful research is almost always portrayed as the work of a lone genius, toiling away in spite of the doubters," said Ryan Julian ('21). "In reality, research is a team sport, and it takes all kinds of people to make a great team. I'm so proud that I got to be a part of the incredible team that made RT-2 a reality."

Julian and his Trojan teammates Karol Hausman ('18) and Yevgen Chebotar ('19) are research scientists at Google DeepMind's headquarters in Mountain View, Calif. The trio, who were advised by Professor Gaurav Sukhatme, contributed to the first-of-its-kind vision-language-action (VLA) model, which The New York Times described as "a quiet revolution."

According to Google DeepMind's Head of Robotics Vincent Vanhoucke in the company's official blog: "Just like language models are trained on text from the web to learn general ideas and concepts, RT-2 transfers knowledge from web data to inform robot behavior. In other words, RT-2 can speak robot." This means it can follow instructions and make abstract connections — the holy grail for robotics.



Computer science doctoral grads Yevgen Chebotar ('19), Karol Hausman ('18) and Ryan Julian ('21) played a key role in Google DeepMind's Robotic Transformer 2.

We sat down with Julian, Hausman and Chebotar to find out more about their journeys from USC to Google, their path to robotics and their visions of the future. Answers have been edited for style and clarity.

When did you realize you wanted to be a roboticist? Was there a lightbulb moment?

RJ Funny enough, I never dreamed I could have a career in robotics. It seemed too far-fetched. I tried several other options but nothing got me as excited and motivated as the robotics club I co-founded as an undergrad. So, I decided to try and make it work for me. It's been a bumpy ride, but I've never looked back. To

this day, I'm amazed and incredibly grateful that I get to do this for a living.

KH It was only after I started my master's in Munich that I realized that I could work in the field of intelligent robots. I was late for my first class and started looking around for a bathroom when I heard strange mechanical noises coming from behind two big white doors in one of the labs. Being curious, I opened the door and saw two human-size humanoid robots making popcorn! It was surreal to realize that intelligent robots exist, and there are people who work on them.

YC The starting point for me was my master's thesis project on robot arm manipulation using tactile sensors. I realized that teaching robots instead of pre-programming them is one of the

most interesting things I could work on and make a difference. I also enjoy working on different things at the same time, so I liked how robotics brought everything together: math, control, learning, vision, etc.

Can you share any interesting or memorable moments during the development of the model? How does it feel to be involved in such a momentous project?

RJ When the model identified and grasped the objects correctly, it was clear we were dealing with something new. Then, we started really pushing for unknown tasks and objects. We saw

the model could now understand pictures, read text, and manipulate objects based on higher-level concepts. Seeing the model performing tasks for which we hadn't collected any robotic data seemed to open a completely new set of opportunities.

KH I remember the first time the model started outputting what looked like robot actions. Yevgen showed me the model running on a real robot, and we were both really surprised. One of us said, somewhat jokingly, that we would look back on this as a big step in robot learning research. I think we were both semi-serious at that time, but it felt like the beginning of something exciting.

YC For me, it was realizing how much the model could go beyond the robotic data. The model we ran on the real robot had 55 billion parameters, probably the largest ever used for robotic control.

How did you all end up working at Google on this particular project?

KH I applied for a research position at Google Brain right after my Ph.D. at USC. In fact, I didn't get into Google for an internship (I applied twice and got rejected both times) and instead interned at DeepMind in London, which I believe prepared me pretty well for my further career at Google and helped me build confidence that Google might be a place for me after all.

RJ While I was at USC, I actually started working with Karol, who had very similar interests to mine. He was a couple of years ahead of me and ended up joining Google after he graduated. We kept collaborating on research, and I joined him at Google as a summer intern. I got really lucky, and Google let me stay as a part-time researcher after my internship. Two years later, I finished my Ph.D., and joining Google again was the natural choice.

YC I also started my interaction with Google during my internships as a USC Ph.D. student. My first internship was on a machine learning project in the speech recognition team. Later, I was lucky to intern on robotics teams at X (formerly Google X) and Google Brain where I could experience working on larger-scale robotics projects. After finishing my Ph.D., Google's robotics team was the best match for me in terms of my research interests.

Looking back, what advice would you give students who aspire to follow a similar career path?

RJ If you want a career in robotics, or any other emerging field or technology, ask yourself if you're ready to be stubborn, and

focus on the long term. Emerging fields are immature and poorly understood, which means career paths working with them are not well-defined or straightforward. Rather than trying to find the single path to your goal, your central task is to keep working in your chosen field, however you can make it work, even if that means making short-term sacrifices and ignoring the zeitgeist. Success is not guaranteed, but it is certainly possible.

What's your long-term dream for robotics and language models?

RJ We have a very good toolbox for teaching robots to follow the rules of the road, or how to assemble exactly the same part over and over again. What we don't have — and what I hope language models can provide — is a toolbox for giving robots grounded intuition for how the real world works. Armed with that intuition, they can start from the facts and expectations the language model contains about the world, and work from there to figure out how to do new things — just like humans do.

KH I would like to see robots being helpful companions in human-centric environments where they can understand the requests of humans around them, rather than these big bulky machines in factories behind safety glass.

YC As our models start to understand the world by transferring knowledge from language and vision, we hope to overcome one of the biggest limitations in robot learning: the scarcity and difficulty of collecting robot data. I hope we will continue to see new generalization results in robotics over the next few years, making robots increasingly useful for society. In the long term, I think melding robotic models with other modalities, such as vision and language, can help us to develop robots that are both capable and easy to communicate with. ■

CLASS NOTES

Cindy Ouellet

M.S. BME '18, PH.D. BME '20

Competed in her sixth Paralympic Games this past summer in Paris, playing for the Canadian team in wheelchair basketball. She also represented Canada in Para Nordic skiing at the 2018 Paralympics in Pyeongchang.

James (Jim) De La Rosa

B.S. EE '81

A retired aerospace engineer who played a key role in designing the Apollo space capsule that ferried astronauts safely to and from the moon and later helped design the space shuttle, has written a book about his contributions to the Apollo project. "Building the Apollo Capsules" delves into the untold story of the Apollo missions, revealing behind-the-scenes events, fabrication procedures and the individuals involved in building the iconic capsules.

Chris Martinez

B.S. CS '94

Has been named chief administrator and strategy officer for The Resurrection Project (TRP), which provides affordable housing and financial education while organizing people to advocate for positive systematic change. Previously, Martinez served as chief operating officer at Housing Forward. He also serves as vice president of the board of Habitat for Humanity Chicago.

Rafael Alvarez

M.S. EE '89

Has been selected for the 2024 Community College Award from the American Association of Hispanics in Higher Education. The award acknowledges individuals who have shown excellence in advocacy, teaching or leadership, and have made substantial contributions to the community college system. Alvarez also serves as the director of the San Diego City College Mathematics, Engineering, Science Achievement (MESA) Program. ■

IN
MEMORIAM



Albert Dorman

M.S. CEE '62

A member of the National Academy of Engineering and founding chairman and first CEO of AECOM, a global infrastructure company, has died. He was 97. His success at AECOM notwithstanding, his most famous achievement was his connection to one of the most popular vacation destinations in the world; as Disneyland’s civil engineer of record, his signature is on the theme park’s original plans. In 2014, USC Viterbi honored him with the Daniel J. Epstein Engineering Management Award at the annual Viterbi Awards, and, in 2016, he was inducted into the university’s Half Century Trojans Hall of Fame. Dorman was also the namesake of several significant USC Viterbi undergraduate academic awards, including the USC Albert Dorman Grand Challenge Scholar Award and the USC Albert Dorman Future Leader Award.



Luiz André Barroso

PH.D. CE '96

Barroso, a computer scientist whom The New York Times credited for “chang[ing] the fabric of the internet” for his pioneering work at Google, has died of cardiac arrest. Barroso was 59. As a VP of engineering in the Core and Maps teams, his work in multicore CPUs and energy-efficient server design at Google shaped the foundation of modern computer architecture and hyper-scale technology. Barroso also co-authored “The Datacenter as a Computer,” the first textbook to describe the architecture of warehouse-scale computing systems. ■

ANDREW
VITERBI BUILDS
ON A LIFETIME
OF INNOVATION
AND GIVING

Viterbi’s recent \$10 million gift, augmented by a \$5 million match, boosts USC President Carol Folt’s Frontiers of Computing “moonshot” by funding the hiring of new faculty at the intersections of advanced computing and other academic disciplines.

BY TED B. KISSELL

WHEN ANDREW Viterbi began his doctoral studies at USC more than five decades ago, he had already left his mark on the world of engineering and computing. At the Jet Propulsion Laboratory in Pasadena, he had been the youngest member of the team that launched the first U.S. satellite, Explorer 1; his doctoral work at USC was largely based on his research into improving communication with spacecraft.

Little did he know that the engineering school that granted him his doctorate would one day bear his name.

After a storied career as a scholar, inventor, entrepreneur and educator, Viterbi turned his attention to helping train future generations of tech innovators. Among their many philanthropic efforts, Viterbi and his late wife, Erna Finci Viterbi, gave the naming gift to USC Viterbi 20 years ago — the largest

naming gift to an engineering school in history at that time.

Now, Andrew Viterbi has given another major gift in support of hiring new interdisciplinary faculty at the just-launched USC School of Advanced Computing.

The new gift of \$10 million establishes an endowed fund to support the recruitment of new distinguished chairs to lead the formation of “faculty affinity groups” (see page 38) at the new USC School of Advanced Computing. Programs related to health, sustainability and security are slated to be among the first chairs endowed.

“This gift is in support of people,” said Viterbi, a USC life trustee who invented the Viterbi algorithm and is one of the co-founders of Qualcomm Inc., a pioneering firm in producing integrated circuits for both satellite and terrestrial

communication, including billions of cellular phones. “I believe in hiring the best professors, which then allows you to build whatever you want to build.

“Faculty with great reputations not only enhance the university’s teaching and research, but more importantly, they attract the best students to follow in their footsteps, rejuvenating the institution and training their successors to preserve our nation’s leadership in science and technology,” he said.

USC President Carol Folt has also allocated \$5 million in matching funds from an existing Lord Foundation gift to further enhance the endowment for hiring distinguished chairs at the School of Advanced Computing, which was established this year within USC Viterbi as part of Folt’s Frontiers of Computing “moonshot.”

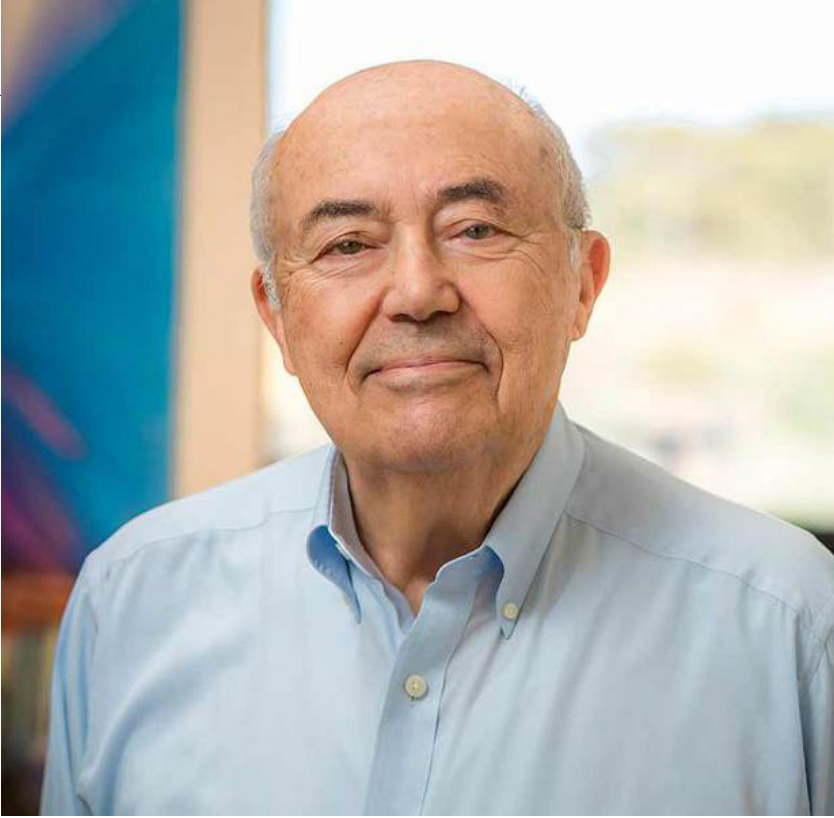
“These distinguished chairs connect advanced computing at USC with the university’s other schools, departments and disciplines, from medicine to social sciences,” Folt said. “Great faculty power Frontiers of

Computing — and the incredible generosity and legacy of Dr. Viterbi ensures our students have access to world-class leaders and top researchers in their fields. I’m especially inspired by the intersection of disciplines that leads to new discoveries supported by this lead gift.”

Yannis C. Yortsos, dean of USC Viterbi, said the school has been “immensely fortunate and proud” to be associated with the Viterbi family. “This new gift further demonstrates Andrew’s commitment to engineering education and to making a better world for all,” he added.

“Andrew Viterbi is a computing pioneer,” said Gaurav Sukhatme, director of the School for Advanced Computing and executive vice dean of USC Viterbi. “His new gift, which will support the work of faculty in diverse areas of computing, reaffirms his commitment to the ideals of a research university. We are very grateful to him and the Viterbi family for their enduring support.”

Sukhatme said that the distinguished chairs will become the leaders



Andrew Viterbi invented the Viterbi algorithm and is one of the cofounders of Qualcomm Inc.

4

SECURITY

to advance cybersecurity, threat detection and prevention, logistics and supply chains, and the identification of misinformation.

5

SCIENTIFIC
DISCOVERY

to accelerate research and advancement in all sciences — physical, chemical, biological, social — with a human- and planet-centric focus.

6

ARTS AND
HUMANITIES

to explore the intertwining of digital technology and humanity on artistic and humanistic expression, creating new philosophical and ethical viewpoints and enriching life for all.

7

QUANTUM
COMPUTING

to explore the frontiers of computing, sensing and communications based on quantum phenomena.

1

HEALTH

to advance personalized medicine, drug discovery and development, medical image processing and analysis, patient data security, health care delivery, and health and medical data analytics.

2

SUSTAINABILITY

to advance decarbonization, energy transition, climate change adaptation, and all matters of sustainability, from transportation to energy transition to urban environments and agriculture.

3

SOCIAL SCIENCES

to explore the application of advanced computing in societal organization; understanding social phenomena; formulating fair, equitable and unbiased policies; and helping to end homelessness, build resilient communities and defend democracy.

For Andrew Viterbi, the kind of collaboration these new distinguished chairs will promote is a logical extension of the support he has given USC for the past three decades.

“Collaboration among faculty, whether in the same department or in other departments, is what pushes us ahead,” Viterbi said. “Working with colleagues, especially colleagues with different academic backgrounds, is a great way to test your ideas — and once they’re polished, sharing them with students is the next great test.” ■

Removing the ‘Hell of
Paperwork’: AI Helps
Truckers, Manufacturers
Come Together



Loop, a Chicago-based startup co-founded by USC Viterbi alumnus Matt McKinney, leverages AI to digitize shipment data, making it easier for manufacturers to spot and reconcile billing errors and for freight companies to get paid on time.

BY MARC BALLON

IN MANY WAYS, trucking is the backbone of the American economy.

In 2022, trucks transported nearly 11.5 billion tons of freight in the United States, representing 72.6% of the nation’s total by weight, according to American Trucking Associations, the industry’s largest trade organization. That same year, more than 3.5 million Americans worked as truck drivers, while another 8.4 million people were employed in jobs related to trucking activity, the trade group added.

Surprisingly, the business of moving goods from one place to another is marked by inefficiencies, confusion, archaic practices and a paucity of technological innovation.

Manufacturers, retailers and logistics companies all too often overpay to have their goods shipped. That’s because they have great difficulty keeping track of and thoroughly reviewing the myriad of invoices and other documents submitted to them by trucking companies, often in the form of handwritten notes, PDFs and Excel spreadsheets for such

The business of moving goods from one place to another is marked by inefficiencies, confusion, archaic practices and a paucity of technological innovation.



things as fuel surcharges and late pickup fees. On the trucking side, it can take weeks for freight companies to receive payment because of invoice disputes, often forcing them to take out high-interest loans to cover expenses.

In this scenario, American consumers also lose. That’s because manufacturers typically hike prices to cover their higher transportation costs. Experts estimate that the producers of cars, clothes, washing machines and other goods overpay by as much as 2% to ship their wares by truck.

RATIONALIZING LOGISTICS
PAYMENTS

Matthew McKinney, B.S. ISE ’13, believes there is a better way. McKinney is the co-founder and chief executive of Chicago-based Loop, a company that, in his words, “aims to unlock profit trapped in the supply chain” by removing friction in logistics payment to increase liquidity for every stakeholder.”

Loop, which also has offices in San Francisco, leverages proprietary artificial intelligence to help logistics businesses digitize shipment data. That makes it possible to quickly resolve any disputes that arise between manufacturers and trucking firms when invoices are higher than agreed-upon contracts due to additional charges. At present, Loop data shows that up to 20% of invoices have some sort of error.

“Our generative AI unifies all this unstructured data so you get a single representative view of the shipment and costs for both sides, with everything cleaned up and normalized in real time,” he said. “If everyone’s on Loop, then you remove all this paperwork and reconciliation hell because now everyone has the same source of truth.”

With Loop, McKinney added, manufacturers can easily scrutinize all invoice and associated charges to make sure they don’t pay too much. Freight firms benefit because they get paid on time or even early.

Additionally, Loop’s workflow automation means that manufacturers and trucking companies no longer need people performing tedious, error prone tasks. Instead, they can refocus their workforce on high-value strategic work. Said Jeff Toman, a finance executive at Loop’s customer Great Dane: “Loop has turned my team from processors to analysts.” ■



THE TRANSFORMATIVE POTENTIAL OF AI: USC'S BILL SWARTOUT CONSIDERS THE FUTURE

BY OMAR LEWIS

THE UNIVERSITY of Southern California's new Center for Generative AI and Society is delving into the fast-changing landscape of artificial intelligence and the potential impacts of generative AI on our world, including culture, media and education. Its primary focus is to promote the ethical use and innovative applications of generative AI to support higher education and to help postsecondary institutions navigate this evolution. Leading the \$10 million center is Bill Swartout, who serves as co-director as well as chief technology officer for USC Viterbi's Institute for Creative Technologies. We recently sat down with Swartout to talk about the center's mission, the transformative potential of generative AI and the ethical considerations guiding the center's research endeavors.



The Center for Generative AI and Society is engaged in various initiatives. Can you highlight one or two projects that you believe will significantly affect our future?

There are two main aspects to the center. One is led by our co-director, Holly Willis, a professor and chair at the USC School of Cinematic Arts, and Mike Anani, an associate professor of communication and journalism at the USC Annenberg School of Journalism. They're examining the impact of AI on the entertainment industry, journalism and the media. The other aspect, in which I'm involved, is a joint venture with the USC Rossier School of Education led by faculty members Gale Sinatra and Stephen Aguilar, postdoctoral student Changzhao Wang, and Dr. Benjamin D. Nye, director of learning sciences at USC-ICT. We're exploring the significant impact of generative AI on education. Another important mission of ours is building a community around AI. We've started a program that we're calling



the AI Generative Fellows Program, where we work with USC faculty members who are interested in using generative AI in their courses.



How is generative AI impacting education?

Generative AI is having a substantial impact on education, and the center is adopting an approach of "embrace and enhance." Some educators advocate for denying or detecting generative AI use, while others, including us, believe in recognizing and embracing it to enhance education. Current detection tools are not very accurate, with false positives being a significant issue. We're working to understand the landscape through surveys, building a community through the AI Generative Fellows Program and developing a framework supporting the use of generative AI in classrooms.



How is the center approaching the ethical considerations associated with AI and addressing concerns about cheating?

Ethical considerations are integral to the fabric of everything we're doing at the center. We're trying to think about how we can use generative AI in a way that improves the student's experience and at the same time reduces the possibility that they would use it to cheat on assignments. It's like the analogy,

which is often drawn, of when calculators appeared decades ago. Education evolved, and now the use of calculators is allowed, encouraged and sometimes even required because it frees up the students to concentrate on the higher-level concepts. That's actually a win. By analogy, that's what we're trying to do here — figure out how we can improve the educational experience and at the same time reduce the stumbling blocks that we would otherwise put in a student's way.

In the context of addressing cheating concerns, we are shifting from grading based on the final artifact to grading based on the process. By using generative AI for "authoring by editing" — where students write a first draft using generative AI and then edit it — students are less likely to cheat, as the focus is on the process and critical thinking. Additionally, we are exploring pre-writing interactions with generative AI to help students explore counterarguments and alternative points of view before they start writing. The aim is to expand their horizon and help them develop critical thinking skills, which are crucial as more text will be generated mechanically in the future.



Can you share any insights into the development of generative AI programs that could be applied to higher education?

We are working on prototypes that use generative AI in various ways, including pre-writing interactions to explore ideas, critique written pieces and identify

narrative elements such as a good hook. We are also developing a software framework for using generative AI in a classroom setting. Initially, we focused on authoring by editing. We are now beginning to explore something we're calling "reverse outlining." The idea is that after a student has written an essay, they could ask generative AI to read the essay and then produce an outline of the essay based on what the student wrote. The value of this could be to let a student see how their essay is perceived — they could see if the organization in the outline matched what they intended and whether or not their ideas came across — and then modify what they wrote to improve it.



The center released its inaugural report, "Critical Thinking and Ethics in the Age of Generative AI in Education," in January. What were the findings?

This survey is an internal report conducted among faculty at USC. Our focus was on examining emerging practices and concerns related to AI that faculty members are observing. We want to understand their perspectives and ideas on this matter. Moving forward, we plan to generate additional reports that extend beyond USC, encompassing national surveys involving both students and faculty across the country. Our objective is to systematically gauge the prevailing sentiments and insights within the AI landscape, providing a more comprehensive understanding than what can be gleaned solely from popular media coverage. ■

◀ In 2023, amid the buzz about generative AI tools like ChatGPT, USC formed the Center for Generative AI and Society with \$10 million in seed money and influential experts from the fields of computer science, film, media, education and more. The center is co-directed by Bill Swartout, a USC Viterbi computer science research professor and chief technology officer for USC Viterbi's Institute for Creative Technologies.



Have You Remembered USC Viterbi In Your Estate Plan?



Bequests play an important role in our mission to educate students from every background as they engineer a better world for all humanity.

The university's gift planning office is available to help you with philanthropic contributions made through wills and living trusts, beneficiary designations for retirement plans, appreciated assets and more.

Please feel free to contact us with any questions about your future goals. Through thoughtful and early planning, we can help you create your legacy. Thank you and Fight On!

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2024 GOLD



**Best Magazine
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(Special Edition - National)

2022 GRAND GOLD



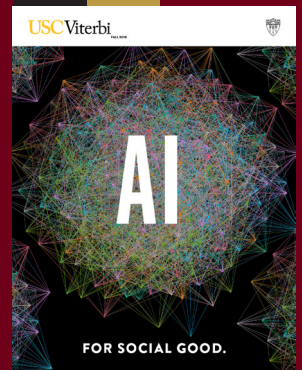
**Best Single-Issue Alumni
Magazine: "Into the Multiverse"**
(National)

2021 SILVER



**Best General
Interest Magazine**
(National)

2019 GOLD



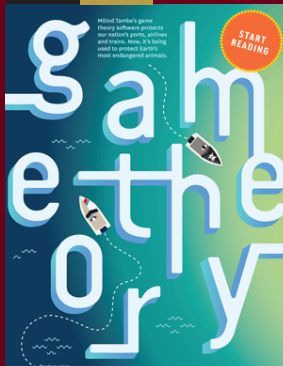
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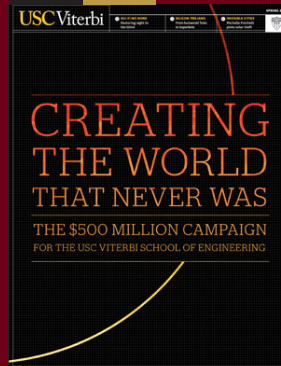
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2013 SILVER



**Best General
Interest Magazine**
(National)