



YEAR IN REVIEW
2018

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Dean's Message

This year marked the golden anniversary for the Donald Bren School of Information and Computer Sciences (ICS). Founded in 1968 as a department at UC Irvine, ICS continues on a path of unprecedented growth 50 years later.

As of fall 2018, undergraduate enrollment nears 3,500 students, more than doubling in five years. Our computer science major has become the third-largest program on campus, and our data science major continues to be our fastest-growing program in the school with now more than 100 students. Graduate enrollment exceeds 600 students, with about 300 students pursuing doctoral degrees, and

“The pages of the 2018 Year in Review are filled with stories that highlight our strategic priorities in the areas of data science, cybersecurity, health, digital media and learning, as well as our continued commitment to diversity and community engagement.”

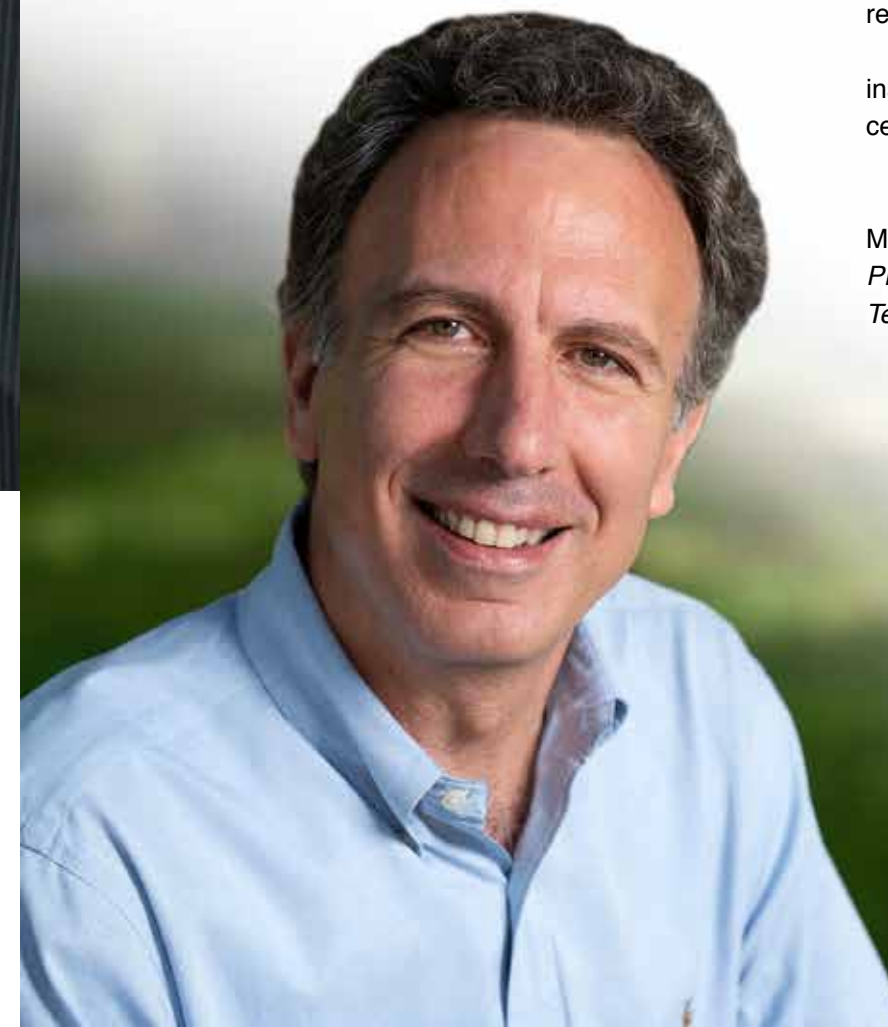
more than 150 new students each year enrolling in our professional programs in computer science and human-computer interaction and design. Despite their rapid growth, our programs are more selective than ever and continue attracting exceptional students, with three of them receiving National Science Foundation Graduate Fellowships and several others recognized with national awards in academic year 2017-18.

Mirroring student growth, our faculty has grown to record levels, with the number of tenured/tenure-track faculty and lecturers in the school surpassing 100 this fall. In recent years, faculty hiring has emphasized the broader space of data science, leveraging the school's traditional strengths in the area of machine learning. We have also invested in the space of digital learning, advancing a new area of excellence for our school.

The pages of the 2018 Year in Review are filled with stories that highlight our strategic priorities in the areas of data science, cybersecurity, health, digital media and learning, as well as our continued commitment to diversity and community engagement. They showcase the groundbreaking work of our faculty, students and alumni, who continue to lead in the exploration of computing technologies and the ways in which such technologies revolutionize the world around us.

As always, I welcome your thoughts, feedback and insights as we continue on this tremendous path of growth celebrating the next 50 years of ICS.

Marios C. Papaefthymiou
Professor of Computer Science
Ted and Janice Smith Family Foundation Dean



ON THE COVER

The red markings on the fingerprint highlight areas used in forensic analysis. Chancellor's Professor of Statistics Hal Stern has studied how to compare fingerprints from a known source (such as a suspect) with those of an unknown source (a print at a crime scene) and how to interpret and report on the results of the comparison. As co-director of the Center for Statistics and Applications in Forensic Evidence (CSAFE), Stern is now part of an interdisciplinary team working to not only validate existing forensic methods but also develop new ones. Read about three ICS faculty members who are involved in CSAFE projects on page 2.

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2018 YEAR IN REVIEW

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ICS faculty advancing forensic science (from left):
Padhraic Smyth, Hal Stern and Charless Fowlkes.



CSI: UC IRVINE

Professors Hal Stern, Padhraic Smyth and Charless Fowlkes are among a growing number of ICS faculty who are helping advance forensic science through their research.

Stressing the importance of statistics in forensic science, Chancellor's Professor of Statistics Hal Stern regularly gives presentations to attorneys and judges, and conducts training sessions for forensic practitioners. "These are the people on the front lines," says Stern, who is also co-director of the Center for Statistics and Applications in Forensic Evidence (CSAFE), funded by the National Institute of Standards and Technology. "We're trying to make them aware of the statistical issues and what we should be demanding of forensic evidence." Such awareness is critical given the growing demand for assurances that forensic analyses have a solid scientific foundation.

"The use of fingerprints in criminal proceedings is more than 100 years old. They can be valuable evidence," notes Stern, "but concerns have been expressed recently about the underlying scientific support for other types of evidence." Stern was first drawn into forensics when he joined an expert working group studying factors associated with the performance of latent print examiners. He's now part of the interdisciplinary team of more than 60 researchers from four universities (UCI, Carnegie Mellon, University of Virginia and Iowa State University) that form CSAFE, which recently received the American

Statistical Association's Statistical Partnerships Among Academe, Industry and Government Award. Stern's current CSAFE project involves working with the Los Angeles Police Department (LAPD) on a study of the complexity of handwritten signatures.

QUESTIONING FORENSICS

Explaining the motivation behind the LAPD study, Stern says that, decades ago, an expert testifying that a fingerprint found at a crime scene matched that of the suspect might have told the jury that "the error rate associated with fingerprint identifications is zero." But a high-visibility case of mistaken fingerprint identity, followed by two extensive reviews of a variety of forensic science disciplines, questioned whether sufficient quantitative data exists to support statements like this being made by some forensic examiners.

Stern also notes that with DNA — the gold standard for forensic evidence — "the bar has been raised for the type of testimony that will be expected regarding other forms of evidence." Research is needed to validate existing methods and to develop new ones, which is where statistics comes into play.

LAPD COLLABORATION

In the absence of mathematically validated approaches, forensic specialists aim to conduct studies that show how well humans perform certain tasks. A handwriting expert in the LAPD is working on one such study, part of which aims to test the current assumption that the more complex a person’s signature, the better the analysis.

As Stern explains it, when it comes to distinguishing between a simulated (forged) and genuine signature, examiners feel that “if someone just does a scribble, it’s a little bit easier to forge and harder to distinguish. So the more bells and whistles a signature has, the stronger the conclusion.” Stern and Bill Thompson, UCI professor emeritus of criminology, law and society, are helping the LAPD expert to plan and carry out the study to determine whether there’s data to back this assumption.

To start, handwriting experts analyzed 123 signatures to subjectively assess their complexity using three- and five-point scales. Stern, with help from statistics graduate students Eric Lai and Shuying Zhu, analyzed that data to determine the consistency of the judgments. Now, they are trying to come up with an objective way to measure complexity using certain measures and characteristics derived from the signatures. “Right now, we’re looking at the distribution of angles in the writing strokes that make up the signature,” says Stern. “Are the strokes primarily slanted or vertical, and does that relate to the examiners’

judgments of complexity?”

The final step for the LAPD study will then be to estimate performance as a function of complexity. “If this all works out,” says Stern, “then the study will provide data that will allow examiners to say, ‘For a highly complex signature, based on the LAPD study, we get it right X percent of the time.’”

APPLYING STATISTICAL METHODS

Can an examiner match a certain handwriting sample to the writing of a given suspect? Can an examiner match this fingerprint from the crime scene to that of a suspect? Can an examiner tell what caused a particular bloodstain pattern at the crime scene? Questioning signature authenticity is just one of many areas that can leverage statistics — and pattern matching in particular — to find more objective and reliable methods of analysis. In fact, Stern isn’t the only ICS researcher conducting research in this area. Computer Science Professor Charless Fowlkes and Chancellor’s Professor of Computer Science Padhraic Smyth are also involved in CSAFE projects (see the “Additional CSAFE Projects” sidebar on page 5).

By bringing statistics and computer science tools to bear on forensic science questions, these ICS researchers are bridging the gap between research and application, furthering their own work while helping to ensure that justice is served — with reliable and valid methods. 🧠

ADDITIONAL CSAFE PROJECTS

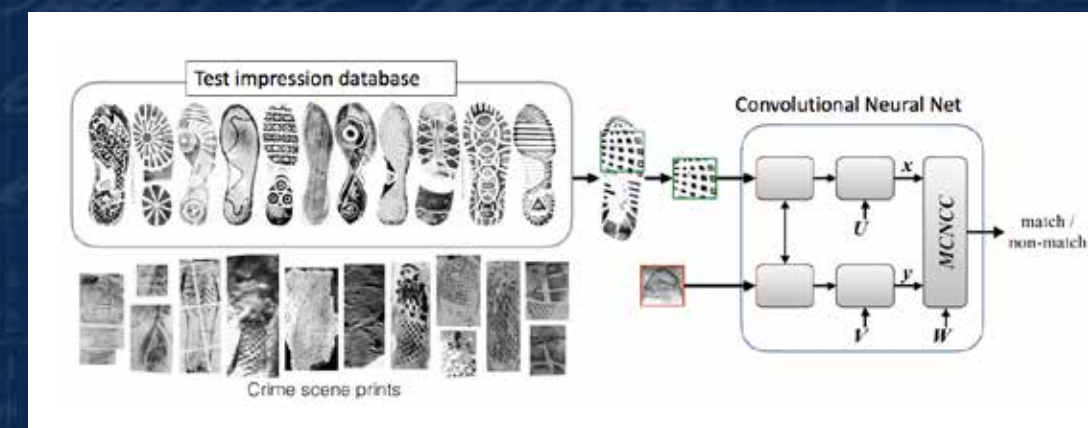
In addition to Professor Hal Stern’s research, Computer Science Professors Charless Fowlkes and Padhraic Smyth are also working on projects for the Center for Statistics and Applications in Forensic Evidence (CSAFE).

CRIME SCENE SHOE PRINTS

Computer Science Professor Charless Fowlkes and computer science Ph.D. student Bailey Kong have investigated how well one can determine what type of shoe left an impression found at a crime scene. In a collaboration with researchers from Carnegie Mellon University, they used data collected by the Israel National Police and a footwear impression database created by researchers at the University of Basel. Fowlkes and Kong were able to use multichannel normalized cross-correlation, applied to

image features extracted with a deep neural network, to obtain state-of-the-art performance in matching crime-scene evidence to a database of shoe prints.

“Our goal is to build automated systems that can assist forensic practitioners in making better use of crime scene evidence,” says Fowlkes, “as well as develop a better basic understanding of what aspects of shoe-tread patterns are reliable in determining whether a print was left by a particular type of shoe.”

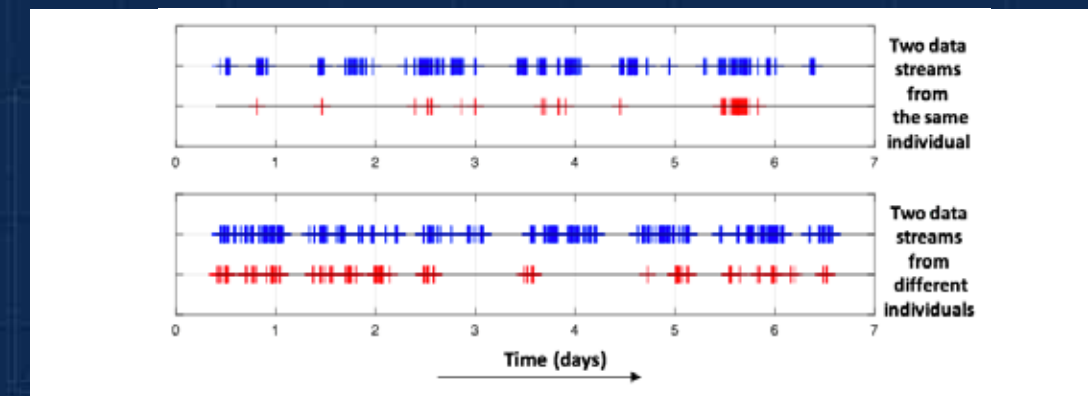


◀ A system for performing automated matching of crime-scene prints to a database of shoe-tread patterns in order to help forensic examiners analyze footwear impression evidence.

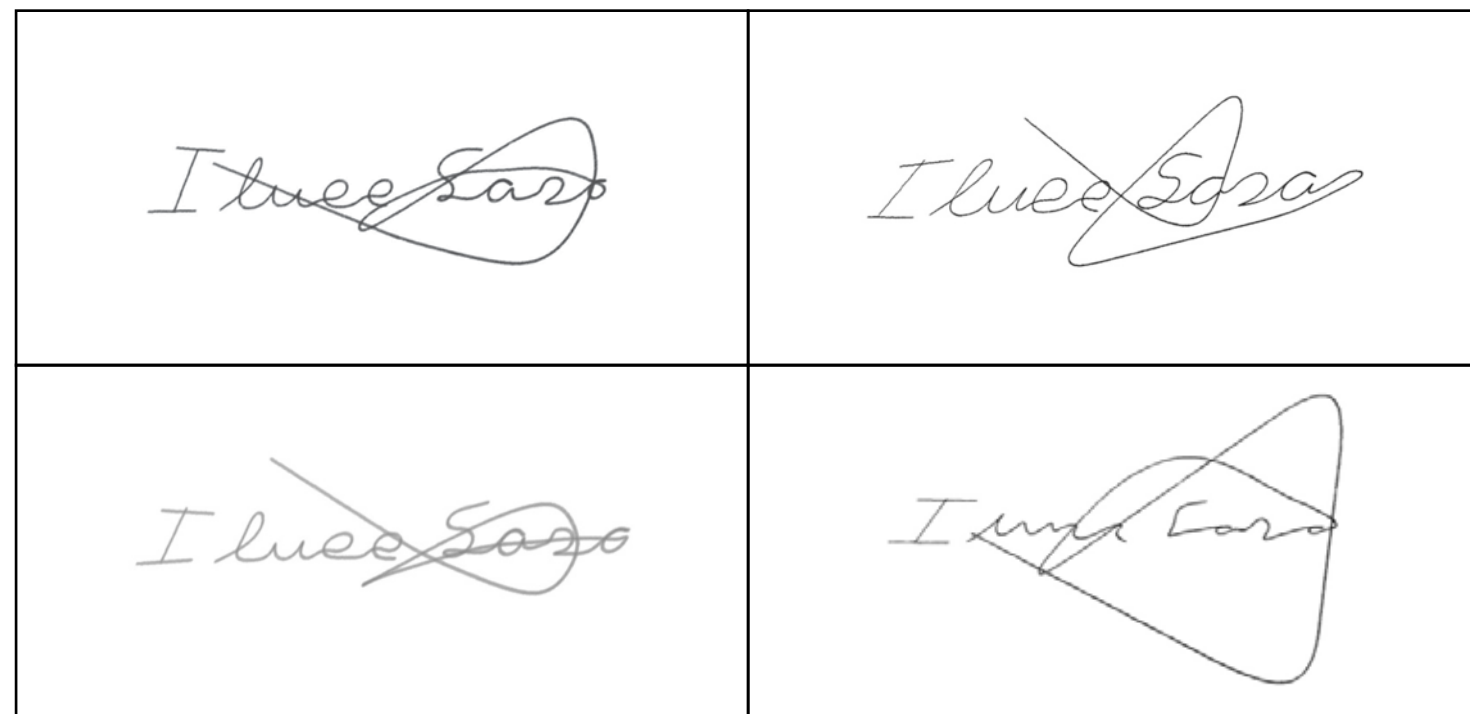
DIGITAL FORENSICS

Chancellor’s Professor of Computer Science Padhraic Smyth and statistics Ph.D. student Chris Galbraith are developing new statistical techniques to support the rapidly emerging area of digital forensics. Digital forensics involves the analysis of data generated by users on digital devices

such as mobile phones. One problem of particular interest is the development of models and methods to determine the relative likelihood that two event-data time series were generated by the same individual or by two different individuals.



◀ Comparing two data streams from the same (top) and from different (bottom) individuals.



Working with LAPD handwriting experts who analyze genuine (left) and simulated (right) signatures, Professor Hal Stern is trying to assess their performance as a function of the signature’s complexity. (The images are from a database of synthetic signatures.)

COMBATING INSIDER ATTACKS

Computer Science Professor Gene Tsudik and two of his Ph.D. students identify and mitigate security threats.



“One of the bigger threats in recent decades is insider attacks,” says Gene Tsudik, Chancellor’s Professor of computer science. “Instead of being attacked by someone thousands of miles away, you’re targeted by somebody you know, such as a rogue co-worker.”

Tsudik is working with computer science Ph.D. students Tyler Kaczmarek and Ercan Ozturk to combat such attacks. The trio of researchers discovered a new class of insider attacks and built a prototype to demonstrate feasibility and identify mitigation strategies.



Up to one minute after a victim enters a password (left), someone with a thermal camera (center) can capture the keys pressed – in this case, “i love you” (right).

INTRODUCING THE “THERMANATOR”

Tsudik, Kaczmarek and Ozturk exploited thermal residue from human fingertips to introduce the Thermanator, a new type of insider attack. Revealing that keyboard-based password entry is even less secure than previously thought, their approach harvests thermal energy (from recent password entry) to illuminate recently pressed keys.

“It’s a new attack that allows someone with a mid-range thermal camera to capture keys pressed on a normal keyboard, up to one minute after the victim enters them,” describes Tsudik. “If you enter your password and step away, someone can learn a lot about it after the fact.”

During a rigorous two-stage user study, Tsudik, Kaczmarek and Ozturk collected thermal residues from 30 users entering 10 unique passwords (both weak and strong) on four popular commodity keyboards. Results showed that entire sets of key presses can be recovered (by nonexperts) as late as 30 seconds after initial password entry, while partial sets can be recovered as late as one minute after entry. The study further revealed that hunt-and-peck typists are particularly vulnerable.

“The attack does not yield the exact password, so there’s no instant gratification,” notes Tsudik. However, people often pick weak passwords, and the heat map limits the possibilities. “Suppose I see the keys that you pressed, and I get 100 plausible password choices. What I can do then is be a patient adversary,” explains Tsudik. “For example, if I know that the maximum number of password attempts per day is three, every day I can try two new candidate passwords. Statistically, after 50 attempts (or 25 days), I have a pretty high probability of succeeding and learning your password.”

Tsudik, Kaczmarek and Ozturk suggest some mitigation strategies, such as swiping your hands over the keyboard after password entry or selecting characters with the mouse from an on-screen keyboard. Regardless, based on their study results, they conclude that Thermanator Attacks represent a new credible threat for password-based systems.

UNVEILING A NEW BIOMETRIC


“We should stop using passwords,” admits Tsudik, “but here we are in 2018, still using them.” Of course, there are other options. Systems can grant access based on what you know (a password), what you have (a token) or what you are (a biometric).

“Ideally, we want something that doesn’t burden the user,” says Tsudik, explaining the motivation behind Assentication, an unobtrusive and continuous hybrid biometric he developed with Kaczmarek and Ozturk based on a user’s seated posture pattern. The novel technique aims to mitigate “Lunchtime Attacks,” which occur when an insider adversary takes over an authenticated state of a careless user who has left his or her computer unattended.

A default security measure for such attacks is an inactivity limit, which logs you out if there’s a certain amount of time with no keyboard or mouse activity. However, because the system doesn’t know if you’ve stepped away or are sitting at your desk reading, it can unjustifiably log you out, which is inconvenient and can result in lost productivity. Furthermore, such an approach merely checks for activity; it doesn’t authenticate the user.

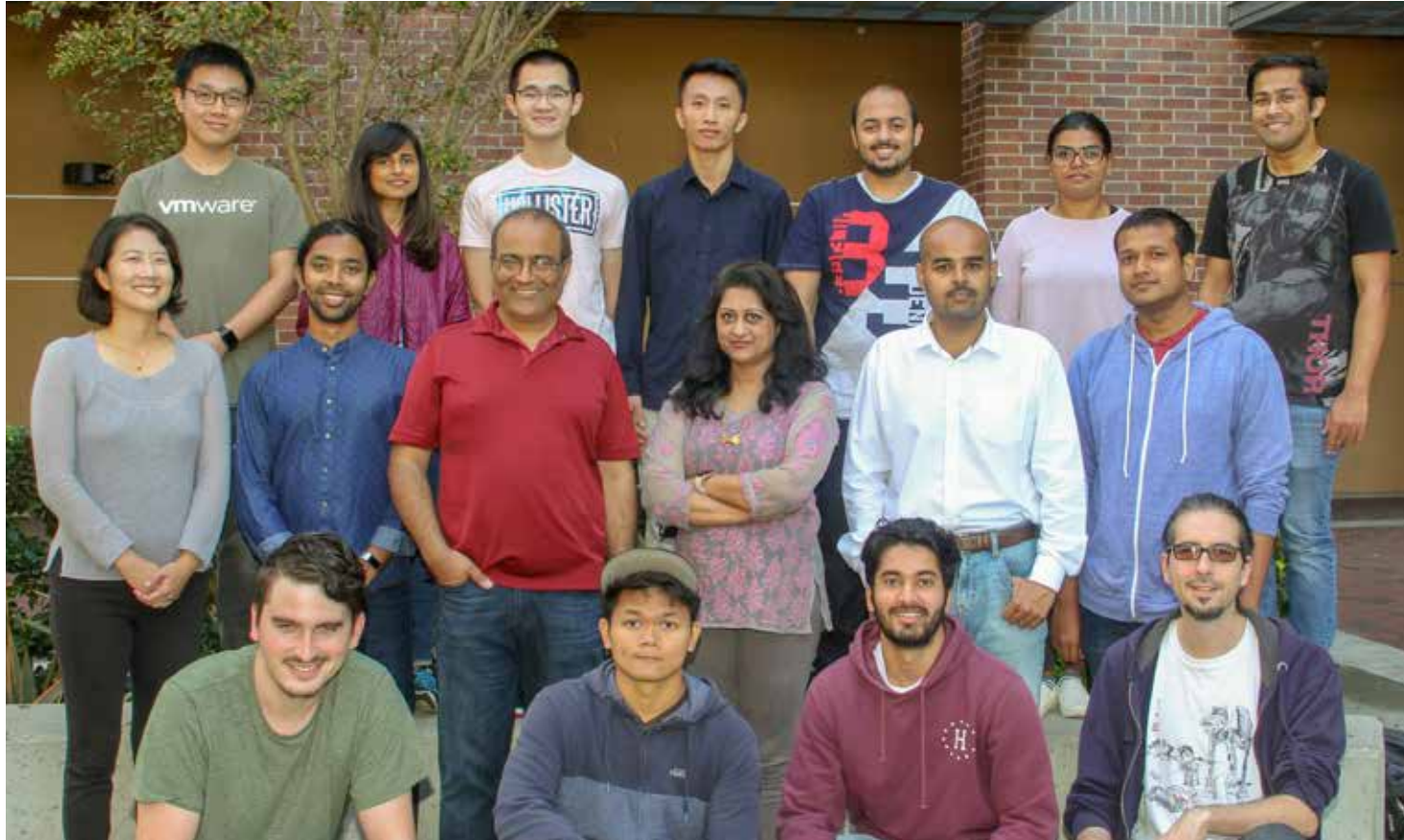
Assentication offers “de-authentication,” quickly terminating the secure session of a previously authenticated user after detecting that user’s absence. By instrumenting the seat and lower back of a standard office chair with 16 tiny pressure sensors, Tsudik, Kaczmarek and Ozturk found a way to capture a unique combination of physiological and behavioral traits to provide continuous user authentication (and de-authentication). Results from user experiments involving a cohort of 30 subjects show that Assentication yields very low false accept and false reject rates. It could even be used in the automotive industry to limit unauthorized car use, though the original design was for an office setting.

“When you sit at your desk in the morning and log in, we build a profile for you based on those sensors,” says Tsudik. “The pressure distributions are quite unique and difficult to imitate, even for people with a similar weight, because of different weight distributions.”

What sets this biometric apart from others is that it’s secure but not extremely intrusive. “Gaze tracking knows when you’re looking at the screen,” says Tsudik. “We don’t know or care what you’re doing.” Furthermore, Assentication doesn’t burden users. “Re-entering passwords and hitting keys to keep from being logged out is a burden. If you’re there but talking on the phone, why should we log you out?” The goal was to take advantage of the fact that you’re sitting and “your posterior makes a unique print.” So users can just sit back and get to work, business as usual. Notes Tsudik: “It’s a zero-effort technique.” 

Privacy in Smart Spaces

ICS researchers use a 'privacy-by-design' approach to develop IoT apps for use in Donald Bren Hall.



The TIPPERS team is working to transform Donald Bren Hall into a smart building.

For over a decade, Donald Bren Hall has been a place of learning for the School of Information and Computer Sciences, but this year, DBH became a more integral part of ICS learning. Led by Computer Science Professors Sharad Mehrotra and Nalini Venkatasubramanian and Informatics Professor Alfred Kobsa, a team of Information Systems Group (ISG) students has been working diligently to transform DBH into a smart building.

The effort, part of the Testbed for IoT-based Privacy-Preserving PERvasive Spaces (TIPPERS) project, involved building a system from scratch that is currently managing more than 7,000 sensors in DBH. Furthermore, this TIPPERS system is dynamically translating raw observations from those sensors into semantically meaningful interpretation (such as occupancy levels in

different parts of the building or the location of people).

Leveraging this data, the team created and tested the following applications:

- **Building Analytics** aims to help administrators identify peak hours of use by analyzing DBH occupancy by floor, region and room.
- **Concierge** is a smart assistant that can help you find people, rooms and events in DBH.
- **Noodle** is a smart meeting organizer that lets you select cameras or microphones to record your meetings.
- **Self-Awareness** can track your DBH interactions so you know where you spend most of your time and with whom (it can even track how many flights of stairs you've climbed).



TIPPERS applications include Building Analytics (left), which analyzes occupancy in Donald Bren Hall, and Self-Awareness, which tracks DBH interactions so users know where they spend most of their time and with whom.



What's particularly unique about the TIPPERS system and these apps is that, by default, they prioritize user privacy.

PRIVACY BY DESIGN

While most apps collect and store everything, these apps collect and process only the information they need, and then discard it.

"We're focusing on privacy by design," explains Roberto Yus, the UCI postdoc fellow leading the development of TIPPERS. Specifically, the project is part of DARPA's Brandeis program, which aims to study the implications of IoT on individuals' privacy.

The challenges of the project are thus twofold. One challenge is developing the complex TIPPERS system with its thousands of sensors. Another challenge, says Yus, "is incorporating the state-of-the-art privacy technologies being developed by our partners in the Brandeis project."

With TIPPERS, users can define their own data-sharing preferences for each request the system receives. So with Concierge, for example, the system will only share your location with a group of friends at lunchtime if you've set this as a preference.

BEYOND DONALD BREN HALL

Access to TIPPERS and its apps has so far been restricted to around 100 people (mostly ISG students in classes taught by Professors Mehrotra and Venkatasubramanian), but that's about to change. "We used this limited release as a mechanism to stress test our system and detect and fix bugs," says Yus, adding that the response has been very positive.

Based on the feedback received, the students are improving their apps and adding new functionalities, but the basic features are available, so the next step is to

release the system and apps to the entire building.

The team also plans to deploy the TIPPERS system in other campus buildings. "We have been working closely with the UCI Office of Information Technology and the Chief Information Security Officer to develop a mechanism to obtain, in a privacy-preserving manner, access to Wi-Fi data from other buildings," says Yus. The system mainly leverages Wi-Fi data to obtain the location of participant users. "Deploying TIPPERS in other buildings will provide the inhabitants with access to the current apps being developed," notes Yus, "but will also open up possibilities for the development of campuswide applications."

A SOURCE OF INSPIRATION

Another application currently under development comes from last year's IoT Hackathon, the first held in the Donald Bren School of ICS. One of the winning teams created ZotBins, a waste-auditing app that monitors trash levels and helps users locate trash and recycling bins (developed by Joshua Cao, Derek Feng, Marshall Nguyen and Owen Yang). ZotBins aims to increase recycling, optimize work for janitors and help identify where more trash cans are needed.

"ZotBins will be the next application that we will release," says Yus, "but it requires the deployment of smart trash cans along the building." The undergrad team working on ZotBins is prototyping a new design of trash cans with several sensors to measure the load.

"We hope that by releasing the system and apps and, more importantly, the interfaces to access TIPPERS data, we will inspire others to create their own applications too."

For more information on the TIPPERS project or to start using the apps, visit tippersweb.ics.uci.edu.

A Healthy Outlook for BIOMEDICAL IMAGING

THROUGH COLLABORATIONS WITH THE BIOLOGICAL SCIENCES AND MEDICAL COMMUNITY, ICS RESEARCHERS PIERRE BALDI, CHARLESS FOWLKES AND BIN NAN ARE IMPROVING DIAGNOSTIC TECHNIQUES AND ADVANCING HEALTHCARE.

“The explosion of artificial intelligence across the board is presenting new opportunities to push AI in medicine,” says Distinguished Professor of Computer Science Pierre Baldi, explaining the motivation behind the Southern California Biomedical Imaging and Machine Learning Symposium held at UCI in June. He worked with Computer Science Professor Charless Fowlkes to organize the symposium, which featured roughly a dozen presentations from researchers at UCI, UC San Diego, UCLA and UC Riverside, showcasing applications of deep learning in biomedical imaging.

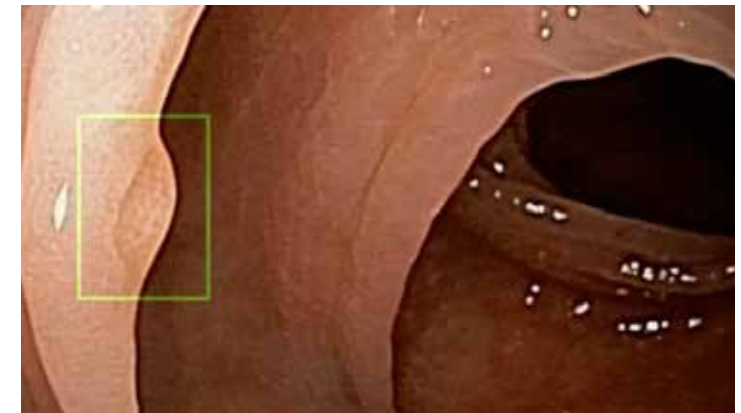
The goal was to inform the campus and community about the latest research, fostering new collaborations and exchanging ideas. “The AI techniques we have can be applied to any type of imaging — ultrasound, microscopy, MRI, functional MRI (fMRI), x-ray ... even cellphone images. The techniques are mature,” says Baldi. “The problem is getting the data.”

BREAKING DOWN SILOS

In search of data, Baldi started reaching out to the medical community three years ago. “I went to see the chair of radiology here at UCI, Professor Sabee Molloi, and I said, ‘Look, we have this AI technology ... can you give me something to test it?’ He gave us breast images and asked to see if AI could estimate the level of calcification.” Baldi and his team were able to measure breast arterial calcifications (BACs), a useful risk marker associated with coronary artery disease. “Now, as a byproduct of getting a mammogram,” he says, “you could be screened for heart disease.”

Baldi and his team have since worked with several other UCI doctors on applications of AI for biomedical images. For instance, in a collaboration with Dr. William Karnes, a UCI Health gastroenterologist, they designed and trained deep convolutional neural networks (CNNs) to detect the polyps in colonoscopies in order to help doctors improve the adenoma detection rate (ADR). Using a set of 8,641 colonoscopy images containing 4,088 polyps, the trained CNN was able to identify polyps with a cross-validation accuracy of 96.4 percent. The system could increase ADR and reduce interval colorectal cancers, but it requires validation in large multicenter trials.

“We were able to get thousands of images from Karnes, but if you could get hundreds of thousands or millions of images, AI would be essentially perfect,” says Baldi. He explains that the barrier is a combination of privacy, legal and societal concerns, as well as the siloed structure of the healthcare system. “When it comes to health, you immediately get into privacy and legal issues, and the system is very compartmentalized,” he says. “So something that



A polyp found using convolutional neural networks is part of Professor Pierre Baldi's collaborative research with UCI doctors.

could happen right away could take 20 years.”

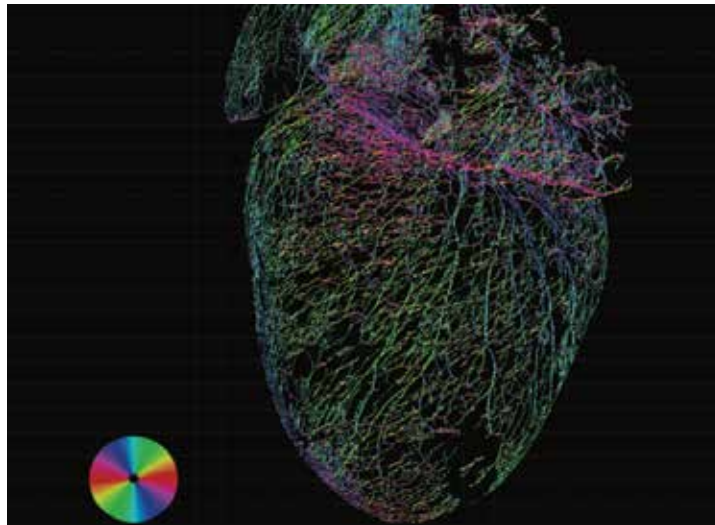
Yet Baldi continues to chip away at the problem. He has numerous projects in the works with fellow UCI researchers, including ones focused on hair loss in dermatology with Dr. Natasha Mesinkovska, cancer metastasis detection in the spine with Professor Lydia Su, and glioma detection in the brain with Dr. Daniel Chow and Dr. Peter Chang. He is also working on a smartphone app with Dr. Petra Wilder-Smith, director of dentistry at UCI's Beckman Laser Institute, which lets users, predominantly in underserved populations, determine whether they have oral cancer using a simple cellphone image. Furthermore, Baldi says the symposium was a success and he will host it again next year, on Oct. 4, 2019, continuing his efforts to forge new collaborations.

MAPPING NEURONS

Fowlkes is also advancing research in this area through his work on a multi-university project, funded by the National Institutes of Health, which will map the peripheral nervous system. “The aim is ultimately to develop therapies that involve stimulating nerves in the peripheral nervous system to relieve different conditions,” he says. Fowlkes is examining bundles of neurons in the heart that keep its muscles beating in the right synchrony. He's also looking at the various layers of control coming from the spinal cord and brain.

By considering the entire regulatory system of neurons, the goal is to help doctors understand the nervous system well enough to identify potential therapies. For example, for heart-attack survivors who develop an arrhythmia, can doctors go in and cut or somehow stimulate the nerve that's sending the wrong signal? This is the type of question Fowlkes is trying to help medical professionals answer.

“The basic science part of it is mapping out the circuits,” he explains. “What different subsets of neurons go to what



Professor Charless Fowlkes is working to trace neurons over the surface of a mouse's heart. Colors indicate the orientation of detected nerve fibers.

parts of the heart, and how are they interconnected?" Using data derived from the image of a mouse heart, Fowlkes is working to trace neurons over the surface of the heart, mapping the pattern to determine which group of neurons control which muscles and so on. "My piece of it is the imaging — making the map of where the wires run," he says.

Fowlkes is also involved in a project that aims to map out the neurons controlling digestion activity in the gut. Teams at UCLA and the California Institute of Technology are doing the imaging, and Fowlkes' team is analyzing the images. "People are excited about this because of recent research suggesting that the microbiome in your gut interacts with your nervous system and affects how you feel," he says. Fowlkes hopes to help doctors understand how and why this is the case.

BUILDING THEORETICAL FOUNDATIONS

Another ICS researcher interested in image analysis is Statistics Professor Bin Nan, with one of his most recent projects focusing on brain functional connectivity. "Neurologists believe that connections between different regions in the brain may tell some story about how the brain works," he says.

Looking at resting-state fMRIs, where brain scans are taken while the person relaxes in the scanner without doing any tasks for five to 30 minutes, neurologists try to estimate the functional connectivity to understand how different locations in the brain are associated. "If we convert that problem into a statistical problem, basically they're estimating correlation coefficients between any two points in the brain," explains Nan.

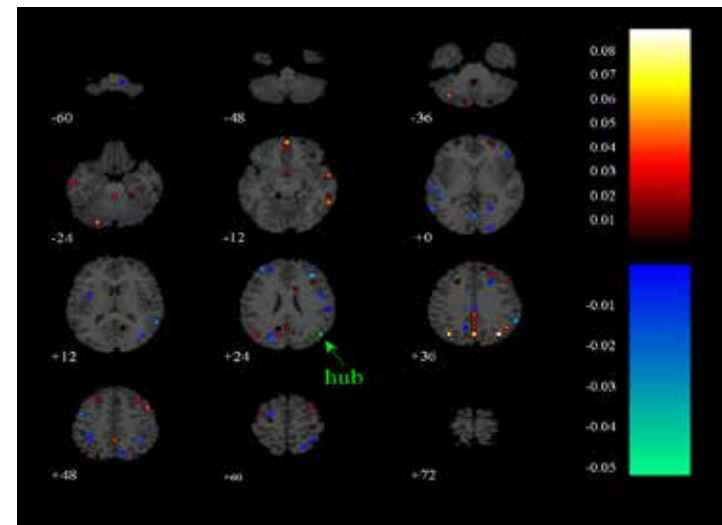
For a set of points (or locations) in the brain, the marginal connectivity refers to their correlation matrix, and

the direct connectivity refers to their partial correlation matrix, which can be found using the inverse of the correlation matrix (the so-called "precision matrix"). If you only focus on a few locations in the brain, the classical estimating methods (using the sample correlation matrix) yield reliable results. However, if you're looking at a large number of locations — for example, at the 3D voxel level — then classical methods won't work.


"If you don't have prior knowledge of where to look, then you should look at the entire brain," notes Nan. The problem is that then you're looking at a quarter-million voxels — a high-dimensional problem requiring new methods.

Furthermore, for resting-state fMRIs, the scans are correlated, because they're repeated measures over time, resulting in very high-dimensional time-series data. "Practitioners haven't been paying too much attention to this," says Nan. "On top of the high dimensionality, they've been ignoring the temporal dependence of observations."

Working with one of his Ph.D. students, Nan found that using regularized approaches with a gap-block cross-validation can improve the estimation precision dramatically. "For time-dependent data, the cross-validation with random partition does not work well," says Nan. "What we do is to create a separation while keeping the time order of the training and validation samples."



Professor Bin Nan's research involves directly connected nodes and their estimated partial correlations to the selected hub.

Developing numerical algorithms for computing the regularized estimates of ultrahigh-dimensional precision matrices effectively is still a challenge. "We were able to establish the theory and methods, and we've computed large matrix estimates with dimensions of thousands," says Nan. "Hopefully such a study will be helpful to neurologists as a theoretical foundation that can guide their scientific research using imaging techniques." 

A BRIGHT FUTURE FOR HEALTHCARE IoT

Multidisciplinary collaboration on four projects is proving how IoT technology can transform healthcare.

How can we leverage the Internet of Things (IoT) to improve our quality of life? UCI's Marie Curie Global Fellow Amir Rahmani asks this question as he explores IoT in a variety of health-related projects.

CREATING A PORTABLE ICU

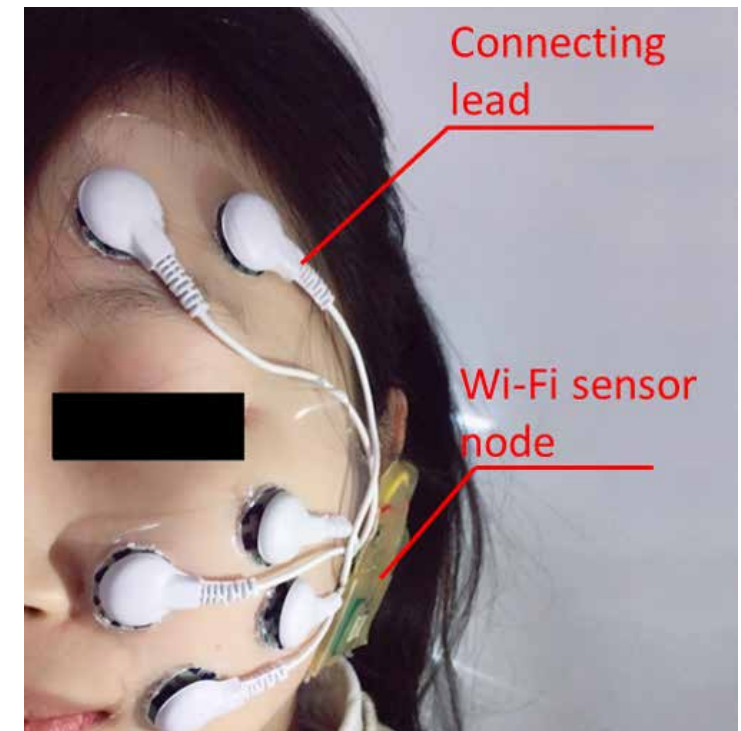
Currently, hospitals use an early warning score (EWS) system to detect health deterioration in patients, which can appear 24 hours before a major health event. The nursing staff manually checks various physiological signs and uses an EWS table to determine the patient's score. If the score goes beyond some level, doctors are alerted.

Although such monitoring can lead to timely medical interventions, keeping patients in the hospital for extended periods of time is costly, says Rahmani. Thus, he's developing a "portable ICU for everyday settings." He uses "IoT technology to automate monitoring in a continuous way, recording the score and sending it to a cloud server." He's working with ICS Professors Nikil Dutt, Kai Zheng and Marco Levorato, as well as with researchers from the University of Turku (UTU), Finland; Turku University Central Hospital, Finland; and VTT Technical Research Centre of Finland Ltd. The group is developing a personalized solution, including a wearable remote-monitoring device for at-risk patients, such as those recently discharged from the hospital.

ASSESSING PAIN WITH IHURT

The next project leverages IoT for pain management. Currently, the nursing staff asks patients to self-report their level of pain — but what if the patient is an infant or sedated?

"We're trying to monitor facial muscle movements and physiological vital signs," says Rahmani. Again working in collaboration with UTU, Turku University Central Hospital, and Dutt and Zheng, as well as with Ariana Nelson in the UCI School of Medicine, Rahmani and the team have designed a mask that can detect three pain levels: none, moderate and severe. They first tested their iHurt mask on 30 healthy patients, using an electrical pulse to stimulate pain, and they now have Institutional Review Board approval to test the device on real patients. Working with Nelson, they have so far tested their system on 20 patients with scheduled operations at the UCI Medical Center to automatically monitor their pain levels in the recovery room.



The iHurt prototype can detect three pain levels: none, moderate and severe.


MONITORING MATERNAL HEALTH

The third project aims to use IoT, smartphones and wearable technologies to develop a remote pregnancy-monitoring system. For a small pilot study conducted in collaboration with UTU and Turku Central University Hospital, Rahmani and Dutt worked with Bren Professor of Computer Science Ramesh Jain and with Yuqing Guo and Adey Nyamathi from the UCI School of Nursing. The group monitored 20 women for seven months, tracking data such as the women's sleep patterns, vital signs, calories burned and steps taken.

Work on this study led to a larger project funded by the National Science Foundation, "UNITE: Smart, Connected and Coordinated Maternal Care for Underserved Communities." Rahmani is now collaborating with Dutt and Levorato, as well as with researchers from the UCI schools of nursing, education and social ecology on a community-enhanced maternal care self-management approach.

EXPLORING AUTISM AND THE CHILD-PARENT RELATIONSHIP

Finally, Rahmani is looking into ways to monitor children with autism and their parents. Still in the very early stages, the project is a collaboration with the UCI School of Social Ecology. The goal is to study the use of wearables to monitor the parent-child relationship and to improve the parent's well-being, thereby ensuring the child receives sufficient emotional support.

"Healthcare IoT is becoming very important," concludes Rahmani. "I see a bright future for this field." 

ESPORTS: A Gateway to Learning

A new esports curriculum leverages student interest in video games and applies near-peer mentorship to better engage students and encourage STEM learning.

“Esports isn’t the next big thing,” says Informatics Professor Constance Steinkuehler. “It’s the current big thing.” Steinkuehler helped launch the Orange County High School Esports League in 2018, which took gaming to a whole new level for the students involved, both competitively and academically. Thirty-eight teams from 25 high schools competed for a spot in the top-16 tournament bracket and a chance to be named league champions. Yet the league’s promise and potential extends far beyond the competition.

“This esports league,” explains Steinkuehler, “has been carefully constructed with an academic framework incorporating science, technology, engineering and math (STEM), English language arts and social-emotional learning, as well as entrepreneurship and career technical education (CTE).”

LEGENDARY LEARNING

During the league’s inaugural season, which ran from January to April 2018, hundreds of Orange County students joined esports clubs at their high schools. Some members played for fun and took on various roles in the club, such as webmaster or shoutcaster, while others made up five-person competition teams playing the online battle arena game “League of Legends,” developed by Riot Games.

The championship game, held on April 28, took place in an esports arena with the final two teams competing on stage in front of a crowd of family and friends loudly cheering them on. And while it was Fountain Valley High School’s Gold Team that took home the trophy, the season turned out to be a success for everyone involved.

According to Steinkuehler, in addition to playing games, club members created websites with expository writing and promotional media. They dug into gameplay data, applying basic math and comparison metrics to figure out how to improve their skills. They learned how to manage their emotions and show respect to other players — whether

they were winning or losing. Some filmed and edited their own news clips for the school television station, while others learned how to replace the processors on lab computers to make them run faster. “Research findings from this first year already show that interest-driven learning in the context of esports can connect kids not only to social-emotional skills but to the standards-based content covered in class,” she says.

BEYOND THE ARENA

The local Orange County league is now expanding across the country as the newly formed North America Scholastic Esports Federation (esportsfed.org). NASEF’s mission is to “provide opportunities for all students to use esports as a platform to acquire critical communication, collaboration and problem-solving skills needed to thrive in work and in life.”

Under the Samueli Foundation’s leadership, NASEF is led by partners from the Orange County Department of Education, the OC STEM Initiative, Connected Camps, UCI’s Connected Learning Lab, UCI Esports, the UCI Henry Samueli School of Engineering and the Donald Bren School of Information and Computer Sciences.

NASEF is now expanding the esports club program, increasing the number of coaches from nine to 60 and adding roughly 10 clinicians, all of whom will be offering a series of workshops and online clinics. Informatics Professor Katie Salen Tekinbaş, who oversees coaching with a partnership through the nonprofit Connected Camps, explains that “if you want to scale, you have to scale at the club level.”

While NASEF is also piloting a standards-based English language arts curriculum for in-class learning (see the sidebar on page 15), Salen Tekinbaş explains that the club program maximizes participation and, through the workshops and online clinics, offers more readily available skills development than the in-school curriculum, which will

take longer to adopt. “You want to create as many entry points for kids as possible,” she says.

The workshops will cover a variety of topics, including fundraising, teamwork, fan art, website development, journalism, shoutcasting and game analytics. “The vision is that, ultimately, the kids are going to be running this league,” says Salen Tekinbaş. So the esports club won’t just legitimize the interests of gamers and fine-tune their STEM-related skills, focusing on model-based reasoning, complex problem solving, collaboration, communication and conflict resolution. Esports clubs will also reach kids with other interests — the artist or community organizer whose talents could be encouraged through a curriculum focused on the “ecology of entrepreneurship.”


Furthermore, all of the esports coaches and clinicians will be college students or recent grads who are former or current professional players with experience working with young people. Most will come from computer science, engineering, game design or interactive media programs. “This near-peer mentorship piece really matters,” explains Salen Tekinbaş. “Having a mentor who shares an interest with you — that encourages people to stay in STEM.” This strategic move aims to provide kids with relatable role models in STEM fields.



Student players at an esports workshop at UCI.

LET THE GAMES BEGIN

Season 2 is upon us, and Blizzard Entertainment’s “Overwatch” is the fall competition game, while “League of Legends” will return in the spring. Fall teams are now in the playoffs, and surprisingly it’s not just schools that are competing. Youth organizations such as the YMCA and the Boys and Girls Clubs are also involved. “There’s interest from different organizations around the country,” says Salen Tekinbaş. “If you maximize participation, you diversify participation, which changes the pipeline over time.”

Growing out of Orange County and across the nation, spilling into classrooms and youth organizations, this esports league is certain to leave its mark in more ways than one as it transcends the arena to transform gaming, the tech industry and future learning. 

HIGH SCHOOL ESPORTS ENGLISH

This fall, a group of teachers at the Samueli Academy, a public charter high school in Santa Ana, Calif., piloted an esports curriculum aligned with the four-year English language arts (ELA) standards:

- **Game Design (9th grade)** — Students will apply literary concepts to analyze and critique how writers and game developers convey meaning to their audiences. Students will also develop their own esports characters and worlds. The course will emphasize oral and written communication, argumentation, design thinking and systems thinking.
- **Entrepreneurship (10th grade)** — Students will read fiction and nonfiction that reflects themes and ideas related to both entrepreneurship and esports. Through these texts and accompanying assignments, students will deepen their understanding of the world around them and expand their skills in speaking, listening, reading and writing.
- **Marketing (11th grade)** — Students will analyze a complex set of ideas, evaluate how an argument is structured and analyze how an author’s style contributes to the effectiveness of the text. Students will develop, refine and test a conceptual model for effective marketing using systems thinking, cause-and-effect thinking, and the collection and analysis of relevant data.
- **Hospitality (12th grade)** — Students will learn and apply career technical education (CTE) hospitality skills by conducting an esports tournament while developing real-world reading, writing, language and speaking skills that will prepare them for college and a career.

“The ELA program was perfect,” says Professor Constance Steinkuehler. “So much reading and writing is done as a natural part of esports. Instead of being a STEM replacement, we created an English program that is infused with STEM lessons.”

Introducing Our New Faculty for 2018



Iftekhar Ahmed

**Assistant Professor, Informatics
Ph.D., Computer Science, Oregon State University**

Ahmed's research focus is on software engineering. In particular, he is exploring how to combine software testing, static analysis and machine learning to create better tools and techniques for improving software quality under real-world conditions. He has used

static code analysis and mining project repositories to identify factors related to source code and develop processes that affect the quality of the software measured in terms of bugs and design issues. He is also examining the effectiveness of mutation testing in automatically uncovering bugs in complex real-world systems. He joined the ICS faculty in September 2018.

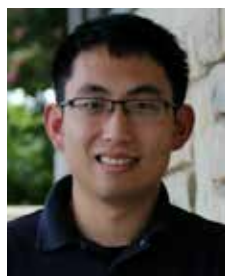


Stacy Branham

**Assistant Professor, Informatics
Ph.D., Human-Computer Interaction, Virginia Tech**

Branham's research sits at the intersection of human-computer interaction and accessible computing, exploring how technologies mediate collocated interpersonal relationships and can inadvertently disempower marginalized people. Her recent

investigations reveal technological threats to safety and well-being as people with vision impairments navigate public spaces, people with disabilities encounter law enforcement, blind parents care for their children, and transgender people encounter gender-recognition algorithms intended to assist blind people. She advocates technology designs that emphasize the interdependence and social integration of all people. She joined the ICS faculty in September 2018.



Qi Alfred Chen

**Assistant Professor, Computer Science
Ph.D., Computer Science and Engineering,
University of Michigan**

Chen's research is on network and systems security, addressing security challenges through systematic problem analysis and mitigation. His research has discovered and mitigated security problems in systems such

as next-generation transportation systems, smartphone OSes, network protocols, DNS, GUI systems and access control systems. Currently, his focus is on smart systems and IoT, including transportation and autonomous vehicle systems. Chen's work has a high impact in both academia and industry with more than 10 top-tier conference papers, a DHS US-CERT alert, multiple common vulnerabilities and exposures, and over 50 news articles by major technology news media. He joined the ICS faculty in July 2018.



Roderic Crooks

**Assistant Professor, Informatics
Ph.D., Information Studies, UCLA**

Crooks studies information and media technology use in minoritized communities through field-based methods, often in the context of public schools. He has explored the application of data science to the complex and politically charged realm of urban

education. Examining how data aggregation, analysis and visualization are spaces of subjectivity and interpretation, he highlights the ways in which the choices data scientists make can influence course curricula and resource allocation. He is also interested in social discovery apps, community archives and digital humanities. He joined the ICS faculty in January 2018.



Daniel Epstein

**Assistant Professor, Informatics
Ph.D., Computer Science and Engineering,
University of Washington**

Epstein focuses on personal informatics, studying how personal tracking technology can acknowledge and account for the realities of everyday life. His research draws on theories and techniques from human-computer interaction, particularly

from ubiquitous computing, social computing and persuasive technology. Using human-centered design methods, Epstein works to understand people's needs through interviews and surveys, designing and evaluating different options through online studies. He then implements and deploys novel systems aimed at better supporting people's tracking needs. He joined the ICS faculty in September 2018.



Sergio Gago Masague

**Assistant Professor of Teaching,
Computer Science
Ph.D., Product Engineering,
Universitat Politècnica de Catalunya**

Gago Masague conducts cross-disciplinary research in assistive and educational technologies, mentoring students in research areas such as product and systems engineering, human-computer

interaction, design and prototyping, data visualization, intelligent user interfaces, computer games and medical informatics. He worked as a research scientist in UCI's California Institute for Telecommunications and Information Technology and serves as director of the Engaging Technology and Application Design Lab. Gago Masague was an informatics lecturer at UCI before joining the computer science faculty as an assistant professor of teaching in September 2018.



Joshua Garcia

**Assistant Professor, Informatics
Ph.D., Computer Science, USC**

Garcia's research interests are in software engineering with a focus on security, analysis and testing, architecture, and maintenance and re-engineering. He leverages static and dynamic analysis techniques, machine learning and artificial intelligence to address

problems related to mobile applications and software architectural decay. Garcia re-engineers software, making it easier to add new features, fix bugs, identify vulnerabilities and determine if those vulnerabilities are exploitable. He is also working to automatically repair exploitable vulnerabilities, particularly in Android apps and IoT systems. He joined the ICS faculty in July 2018.



Sang-Woo Jun

**Assistant Professor, Computer Science
Ph.D., Electrical Engineering and
Computer Science, MIT**

Jun's research interests include systems and software for big-data analytics, aiming to boost performance and lower costs using field-programmable gate array (FPGA)-based application-specific hardware acceleration

and non-volatile memory (NVM) storage. He focuses on many applications, including graph analytics and bioinformatics. Jun also served as a software developer for interactive entertainment software company Nexon Inc. and had an internship at Oracle's Big Data Discovery. He joined the ICS faculty in September 2018.



Stephan Mandt

**Assistant Professor, Computer Science
Ph.D., Theoretical Physics, University of Cologne**

Mandt was a senior research scientist and head of the Statistical Machine Learning Group at Disney Research, LA. Previously, he was a PCCM Postdoctoral Fellow at Princeton University, a postdoctoral researcher with David Blei at Columbia University and a Ph.D.

fellow of the German National Merit Scholarship Foundation. Mandt has three patents pending; over 14 publications with conferences such as NIPS, ICML and CVPR; and nine articles in journals such as the *Journal of Machine Learning Research* and *Physical Review Letters*. His interests include scalable probabilistic modeling, Bayesian deep learning, variational inference, and applications in the sciences and digital media. He joined the ICS faculty in October 2018.



Kylie Pepler

**Associate Professor, Informatics and
School of Education
Ph.D., Education, UCLA**

An artist by training, Pepler utilizes design-based research methods to reconceptualize learning environments, particularly at the intersection of the maker culture, systems thinking and new computational technologies.

She studies the creative uses of computer programming among youth communities and focuses on the design and study of e-textile artifacts. This work has resulted in numerous publications, including a four-book curriculum through MIT Press. Pepler was an associate professor of learning sciences and director of the Creativity Labs at Indiana University prior to joining the ICS faculty in September 2018.



Jennifer Wong-Ma

**Associate Professor of Teaching, Computer Science
Ph.D., Computer Science, UCLA**

Wong-Ma's research interests are in architecture, wireless and distributed embedded systems, hardware intellectual property protection, and statistical optimization. Before coming to UCI, she was a teaching faculty member in the Computer

Science Department at Stony Brook University, where she also served as an undergraduate program adviser and coordinator for the five-year joint BS/MS computer science program. While at Stony Brook, Wong-Ma received the CS Department Award for Undergraduate Education and the Award for Major Contributions to Undergraduate Education, showing her devotion to teaching sophomore- and junior-level systems and architecture courses. She joined the ICS faculty in September 2018.



Hadar Ziv

**Associate Professor of Teaching, Informatics
Ph.D., Information and Computer Sciences, UC Irvine**

Ziv earned his Ph.D. from ICS, using Bayesian networks to model software uncertainties. His principle that uncertainty is inherent and inevitable in software engineering, dubbed Ziv's Law, influenced thought leaders in Agile and SCRUM methodologies. He is a

mentor of Agile methods and host of the popular Agile Open gathering at UCI. Ziv teaches regular and software project courses, including the Informatics Capstone, empowering students to tackle real-world problems. Having been at UCI for more than 30 years, including his years as a student, he became an associate professor of teaching in June 2018.

Faculty Highlights



MARK RECEIVES \$8M GRANT TO STUDY WORKPLACE PERFORMANCE

Informatics Professor Gloria Mark is co-lead on Project Tesserae, a study to predict workplace performance using mobile sensors, which has received \$8 million in Intelligence Advanced Research Projects Activity (IARPA) funding. Mark has teamed up with

researchers from eight other universities on this 21-month study of 750 professionals who work in cognitively demanding positions. During the study, participants will wear an activity tracker paired with a smartphone app to gauge biomarkers, such as heart rate, sleep, physical activity and stress, and daily patterns. Passive sensors will also collect information about the workplace, such as ambient noise and light levels, to contextualize participant activity. To address activity and behavior within the context of the workplace, the de-identified sensor data then will be analyzed by the researchers.



FRANZ AWARDED \$3M NAVAL RESEARCH GRANT, RECEIVES INNOVATOR OF THE YEAR AWARD

The Office of Naval Research awarded \$3.15 million to Chancellor's Professor of Computer Science Michael Franz for a three-year grant, "Attack Surface Reduction for Binary Programs." Specifically, \$2.33 million will go to UCI, and the remaining funds will go to Dr. Herbert Bos, a collaborator on the project at Vrije Universiteit Amsterdam. The goal is to increase software security by first stripping programs down to the basics and then rigorously analyzing and optimizing what is left. As Franz explains, "The attack surface describes all the different places that you have to defend, and if you have a smaller program, there's less to defend."

Franz also received the inaugural Innovator of the Year Award from UCI Applied Innovation in 2018 for his work with startup computer security company Immunant Inc. The award aims to recognize researchers who have developed a breakthrough idea, process or technology and have demonstrated its transformational potential to improve lives and create economic value. As part of the award, Franz received \$10,000 to support his lab. Franz credited his researchers who helped develop the ideas in the lab at UCI and, after completing their Ph.D.s, are now building Immunant at UCI Applied Innovation.

OLSON ELECTED TO NATIONAL ACADEMY OF ENGINEERING

Informatics Professor Emerita Judy Olson was one of two UCI faculty members (and 83 nationwide) elected to the National Academy of Engineering in 2018, one of the highest professional distinctions accorded to those pursuing research, education and applications in engineering and technical fields. Olson was commended for her leadership, technical innovations and development of systems that support collaborative work at a distance.



SHAHBABA RECEIVES \$1.7M GRANT TO DEVELOP NOVEL MODELS FOR NEURAL DATA ANALYSIS

Statistics Professor Babak Shahbaba has been awarded a \$1.7 million National Institutes of Health grant that could have far-reaching implications for future efforts to address memory impairment. The research involves electrophysiological experiments in rats to study how a brain structure (the

hippocampus) supports our ability to remember the daily events of our life. Furthermore, the research should lead to new methodologies for handling huge amounts of complex data. The five-year grant, "Scalable Bayesian Stochastic Process Models for Neural Data Analysis," is a multidisciplinary collaboration between Shahbaba, fellow Statistics Professor Hernando Ombao and UCI Associate Professor of Neurobiology and Behavior Norbert Fortin.



GOODRICH ELECTED TO ROYAL DANISH ACADEMY OF SCIENCES AND LETTERS

UCI Chancellor's Professor of Computer Science Michael Goodrich was elected as a foreign member of the Royal Danish Academy of Sciences and Letters in 2018. Goodrich is a leader in the field of algorithm design, where he

is highly recognized for research in geometric computing, networking, geographic information systems, computer security and big-data processing. His recent work has focused on fundamental problems such as sorting, convex hull construction, nearest-neighbor searching, linear programming, privacy-preserving data access and data authentication.

EPPSTEIN NAMED AAAS FELLOW

Chancellor's Professor of Computer Science David Eppstein was one of 10 UCI researchers named a fellow of the American Association for the Advancement of Science (AAAS), an organization that seeks to advance science, engineering and innovation throughout the world for the benefit of all people. AAAS recognized Eppstein for his distinguished contributions to graph algorithms, computational geometry and graph drawing. With Eppstein, ICS now has nine AAAS Fellows.



NAN RECEIVES \$1.2M GRANT TO DEVELOP NEW STATISTICAL METHODS

While previously working on studies related to aging populations and patients with kidney disease, Statistics Professor Bin Nan came across a set of emerging issues that could not be resolved using standard methods. So he decided to explore new methods, becoming the principal

investigator on a grant titled "Cutting Edge Survival Methods for Epidemiological Data." The National Institutes of Health recently awarded Nan and his co-investigators at UCI \$1.2 million to develop the methods over the next four years. In particular, Nan is working with his colleagues to address three main problems in longitudinal cohort studies: delayed entry, covariate censoring and modeling terminal events.



BOWKER RECOGNIZED AS DONALD BREN PROFESSOR

ICS held a special event in the spring to formally recognize Geoffrey C. Bowker as Donald Bren Professor in Information and Computer Sciences. Bren Professors are collaborative and creative individuals leading research that results in major discoveries and transformations and making positive contributions to both UCI and the community.

Bowker joins current Donald Bren Professors Michael Carey and Ramesh Jain, and emeriti faculty members Judy Olson and Gary Olson. During the celebration, Bowker, who serves as director of UCI's Evoke Lab and Studio, delivered a thought-provoking lecture titled "How the West Was Won by Data," which connected trends and events dating back as early as the 18th century to the data-focused headlines of today's newspapers.

TSUDIK RECEIVES 2017 ACM SIGSAC OUTSTANDING CONTRIBUTIONS AWARD

Chancellor's Professor of Computer Science Gene Tsudik received the ACM SIGSAC Outstanding Contributions Award at the 2017 ACM Conference on Computer and Communications Security for his leadership in security and privacy research. The award is given for significant contributions to the field

of computer and communication security through fostering research and development activities, educating students and providing professional services such as the running of professional societies and conferences.



BALDI AWARDED GRANT TO ANALYZE CIRCADIAN RHYTHMS

Distinguished Professor of Computer Science Pierre Baldi has received a \$980,000 grant from the National Institutes of Health to develop tools that will lead to insights into circadian oscillations and their role in health and disease.

He is the principal investigator on the grant, "Bioinformatics Tools for Circadian Biology," which runs through April 2020. Circadian rhythms coordinate many

important biological functions, from the sleep-wake cycle to metabolic activities and cognitive functions. Disruptions of circadian rhythms have been linked to health problems ranging from depression to cardiovascular disease, and research suggests that understanding circadian oscillations at the molecular level could impact precision medicine. Baldi, who is also the director of UCI's Institute for Genomics and Bioinformatics, will be working closely with biologists to develop informatics tools to collect, integrate and analyze molecular circadian data. Capturing this wealth of information could lead to novel insights about the organization and regulation of circadian oscillations, their role in health and disease, and their future application to precision medicine.



CHEN STUDYING HEALTHCARE TECHNOLOGY'S IMPACT ON OLDER ADULTS

Informatics Professor Yunan Chen has received a Council on Research, Computing and Libraries (CORCL) grant that will help her study how older adults can use smartwatches for exercise tracking. In particular, the smartwatch app will help seniors with diverse health conditions create personalized exercise goals each day, so Chen can investigate the impact of adaptive exercise tracking. Her pilot intervention study aims to better promote exercise in older adults by establishing achievable goals. The two-phase study will first explore usability, focusing on how best to design the smartwatch app interface for seniors. During the second phase, seniors will use the app for two weeks. Half of the participants will be in the intervention group, which will receive daily adaptive exercise goals based on the data collected. The other half, the control group, will have predetermined, fixed goals. At the end of the study, Chen will analyze the experiences of the two groups and compare their exercise amounts. The results should help develop a better understanding of self-tracking technologies for seniors' health management. Chen eventually hopes to conduct the study on a much larger scale to generate insights to inform the design of healthcare technology for older adults.



DUTT AWARDED NSF GRANT FOR 'INFORMATION PROCESSING FACTORY' COMPUTER CHIPS

Chancellor's Professor of Computer Science Nikil Dutt and Professor of Electrical Engineering and Computer Science Fadi Kurdahi have received a \$900,000 research grant from the National Science

Foundation to investigate the development of next-generation "information processing factory" chips that build on recent innovations in manufacturing in which network-connected tools, robots, sensors and computers act in concert to perform complex processes. The project is in tight collaboration with and complemented by a parallel German Research Foundation-funded research project at the Technical University of Braunschweig and Technical University of Munich. The advanced chips being designed will come equipped with on-chip sensors to monitor and control performance and health status – keeping track of temperature, energy consumption, wear and tear, and even security threats. Achieving this will require a holistic methodology that encompasses hardware design, software development and new approaches to network architecture.



MALEK, GARCIA AIM TO TRANSFORM SOFTWARE ARCHITECTURE RESEARCH WITH \$1.66M GRANT

Informatics Professors Sam Malek and Joshua Garcia have started working on a three-year \$1.66 million National Science Foundation grant, "Constructing a Community-Wide Software Architecture Infrastructure," which is a collaborative project involving faculty from UCI, USC and the Rochester Institute of Technology. Malek and Garcia will lead the UCI team, composed of graduate student researchers working out of the Institute for Software Research (ISR). The goal is to develop the Software Architecture INstrument (SAIN), a first-of-its-kind integration framework for assembling architecture-related tools and techniques, enabling empirical research in the context of software maintenance.



LEVORATO COLLABORATES ON \$3.8M GRANT FOR ELECTRICITY DISTRIBUTION CYBERSECURITY

Associate Professor of Computer Science Marco Levorato is part of a multidisciplinary team that aims to investigate the impact of cyberattacks on electricity distribution infrastructure. The

team includes researchers from UCI, UCLA, UC Santa Barbara and the Lawrence Livermore National Laboratory (LLNL). Through their grant, "UC-Lab Center for Electricity Distribution Cybersecurity," they will receive \$3.75 million between now and February 2021. The grant was awarded as part of the UC Laboratory Fees Research Program, which aims to enhance partnerships between UC researchers and laboratory scientists at LLNL and the Los Alamos National Laboratory. Levorato's role in the project is the investigation of security vulnerabilities at the intersection between communication networks and the distribution system. His group will focus on developing new modeling approaches that capture the interdependencies between these networks and systems. The overall goal is to create new strategies for mitigating vulnerabilities, detecting intrusions and protecting against systemwide attacks. The team will also work to secure distributed energy resources, such as solar panels and energy-storage devices, and electricity distribution networks, building a new knowledge base to address both theoretical and practical challenges in electricity distribution cybersecurity.



GILLEN RECEIVES \$1.2M GRANT TO INVESTIGATE ALZHEIMER'S DISEASE CLINICAL TRIAL STUDY PARTNERS

Furthering work started last year, Professor Dan Gillen, chair of the Department of Statistics, is continuing to collaborate on Alzheimer's disease (AD) research with UCI School of Medicine

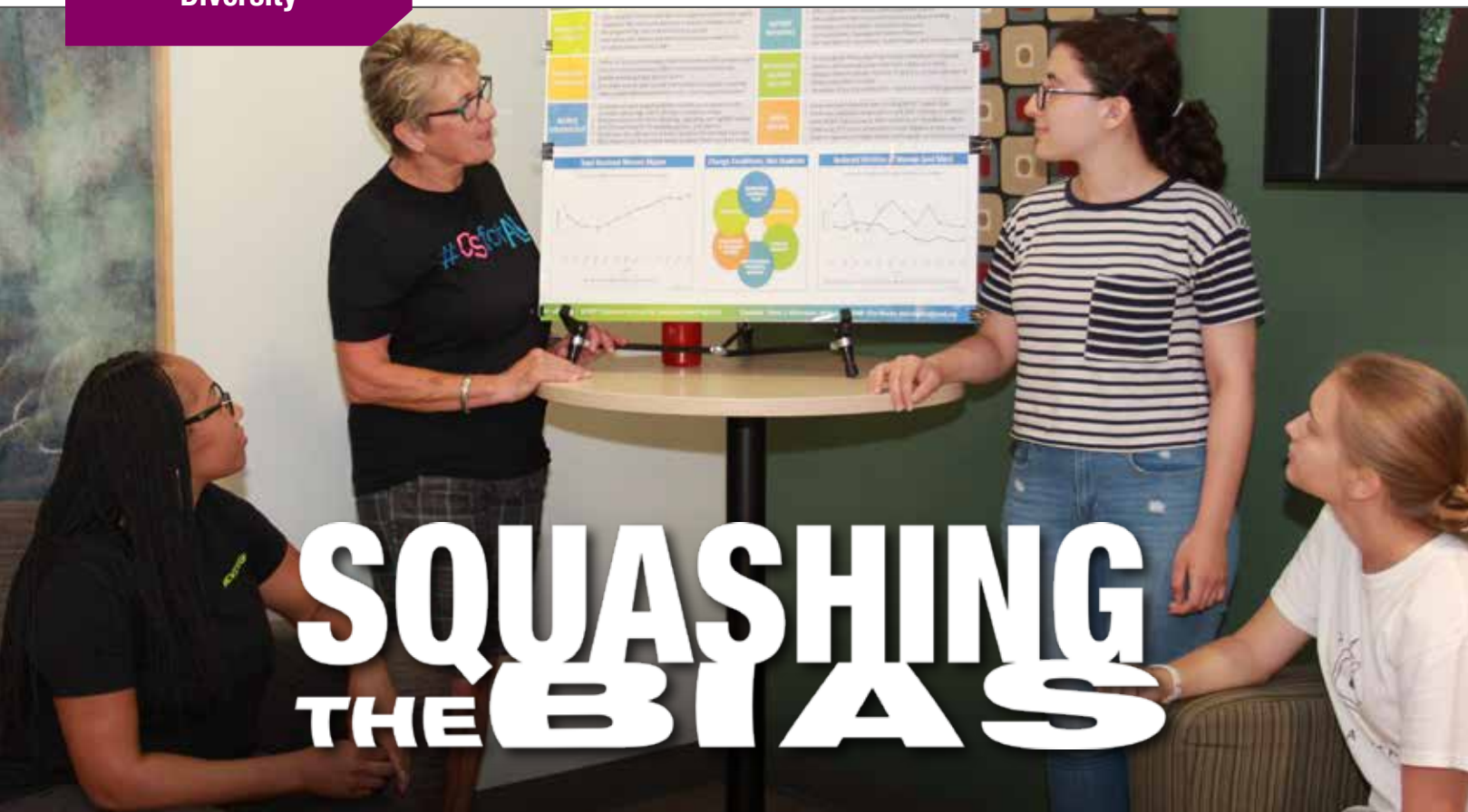
Professor Joshua Grill, who is also director of the UCI Institute for Memory Impairments and Neurological Disorders (MIND). With their new four-year \$1.2 million National Institutes of Health grant, "Effects of Alzheimer's Disease Clinical Trial Study Partners," Gillen and Grill aim to help researchers better understand how study partners for AD patients affect clinical trial data. Performing modeling experiments, they will investigate how altering trial enrollment patterns and protocol decisions affect trial data precision and accuracy. They will then develop software that incorporates their results to help trialists better plan their studies. The newly generated software will be incorporated into Gillen's existing R software package, RCTdesign, a comprehensive package for designing,

monitoring and analyzing group sequential and adaptive clinical trials. According to the proposal, "this project will yield a greater understanding of study-partner impact on trial data integrity, and will enable improved design and conduct to reduce missing data and increase statistical power and data validity."

IN THE NEWS



- "The Doctors" TV show on CBS featured a segment on **Gene Tsudik's** latest cybersecurity research (filmed July 18, 2018).
- *U.S. News and World Report* published an article written by **Constance Steinkuehler**: "Schools use esports as a Learning Platform" (June 12, 2018).
- CNN interviewed **Bryan Cunningham** as a cybersecurity expert: "Trump ramps up personal cellphone use" (April 14, 2018).
- C-SPAN broadcast the Cybersecurity Policy and Research Institute's "Election Hacking and the Future of Politics" event featuring James Carville and CPRI's **Bryan Cunningham** (March 13, 2018).
- *The Los Angeles Times* interviewed **Mimi Ito**: "UC Irvine academics come to the defense of players after WHO proposes 'gaming disorder' as a thing" (Feb. 8, 2018).
- *The Pittsburgh Post-Gazette* published a book review by **Michael Goodrich** titled " 'Leonardo Da Vinci': Walter Isaacson goes back to Renaissance for his latest biography of a genius" (Jan. 27, 2018).
- *The Lakeland Times* interviewed **Hal Stern** for an article titled "Autism numbers spike: The latest call to action" (Jan. 22, 2018).
- *PC Magazine* featured **Marco Levorato** in an article titled "Inside DARPA's Hackfest at NASA Research Park" (Dec. 1, 2017).
- *The Daily Pilot* interviewed **Magda El Zarki** for an article titled "UCI computer game explores culture of 18th-century Ghana" (Nov. 10, 2017).
- *WalletHub's* article "2017's States Most Vulnerable to Identity Theft and Fraud" featured **Paul Dourish** among a panel of experts (Oct. 18, 2017).



Funded by a \$100,000 Grand Prize NEXT Award, ICS is kicking off an innovative program aimed at encouraging people to recognize and reflect on implicit biases.

When the Donald Bren School of Information and Computers Sciences (ICS) received the 2016 Excellence in Promoting Women in Undergraduate Computing Award (see bit.ly/ICS-NCWIT16) from the National Center for Women and Information Technology (NCWIT), Debra Richardson (pictured above, top left), the founding dean of ICS, exclaimed that she was “extremely proud of this recognition for what we have accomplished thus far.” However, she also recognized that “we still have a long way to go.”

Fortunately, the \$100,000 Grand Prize for the NCWIT Extension Services Transformation (NEXT) Award also went to ICS that year. The prize money is given to “reward practices that NCWIT recognizes as having the most significant impact on the long-term goal of increasing the number of women in information technology and other computing-related fields.”

So Richardson started brainstorming on how best to apply the \$100,000, working closely with Sharnnia Artis (pictured above, bottom left), assistant dean for access and inclusion for ICS and the Samueli School of Engineering. Because there were no spending restrictions other than using the funds to support the recruitment and retention of women in computing, they wanted to create something different — something fun and informative.

Artis, herself a “rising star” in promoting diversity (see sidebar on page 23) says that ICS already receives funding from companies for outreach initiatives and student support, and they didn’t want to duplicate those efforts. Instead, Artis and Richardson decided to focus on cultivating an inclusive environment in computing and ICS by creating a movement around squashing implicit biases through active bystanders.

SQUASHING THE BIAS

Focusing on implicit bias is “something that we thought could be really transformative for the school,” notes Artis. Richardson and Artis knew that they had to come up with something engaging — not just another seminar or lecture. So they designed “SQUASH the Bias,” a series of events aimed at encouraging the ICS community to “Start Questioning Us About Stereotypes Held.”

“Unconscious or implicit biases shape our expectations of others, especially those who are different from ourselves,” says Richardson. “We all hold them, myself included, although they’re contrary to our conscious beliefs. Once we are consciously aware of our negative unconscious biases, we can then learn ways to talk through, overcome and change them.” That’s the goal of the SQUASH the Bias series, which features one event per quarter, targeting the entire Donald Bren School of ICS,

including students, faculty, staff and leadership.

“We’re trying to shift the thinking about diversity so everyone has a role,” says Artis. “We want it to be all hands on deck.”

STARTING A DIALOGUE

The series kicked off this fall with a theatrical performance by Pure Praxis, a social theater group dedicated to cultural change. The group demonstrated typical scenarios faced and led a discussion about what people witnessed during the performance. “It’s an engaging way to have these tough conversations,” says Richardson.

There were three performances on Oct. 3 — one for graduate teaching assistants, another for all graduate students across ICS and engineering, and a third for faculty across the two schools — followed by an evening reception that continued the conversation and celebrated the kick off.

HOSTING A DIVERSITY FAIR

The second event in the series will be a resource fair in the winter, bringing together a variety of campus organizations focused on bystander change. Such organizations include:

- the **LGBTQ Resource Center**, which provides support, education and advocacy from an intersectional perspective regarding sexual orientation/attraction and gender identity;
- the **Campus Assault Resources and Education (CARE) Office**, which offers free and confidential support services to members of the UCI community impacted by sexual assault, relationship abuse, family violence and/or stalking; and
- the **Dreamers’ Resource Office**, dedicated to serving the AB540 and undocumented student population through advocacy, guidance and support.

“We want to have a fair where all of these organizations come into ICS to not only share what they do but to also give tips to those of us who aren’t in that space,” explains Artis. So, for example, people unfamiliar with the LGBTQ community can come ask questions and learn how to be more supportive and engaged. In addition to those who are already advocates and champions in this space, the goal is to attract those who typically might not go to a diversity event — who have an interest but don’t know how to get involved.

LEARNING FROM LEADERS

The series will wrap up in the spring with a panel of leaders from academia and industry who have changed the culture of their respective institutions. The focus of the discussion will be best practices for changing institutional culture and the target audience will be faculty, leadership and staff, so they can hear what other institutions are doing and can implement similar practices at UCI.

CREATING A MOVEMENT

SQUASH the Bias has been two years in the making, but it has finally made its debut with Richardson and Artis applying the NEXT funding to start a movement.

“We don’t want to talk at people. We don’t want people to be offended. We want people to be empowered and to know that they can make a difference,” explains Artis. “There’s something for everyone in this movement.”



A Rising Star

In May 2018, Assistant Dean of Access and Inclusion Sharnnia Artis received the Rising Star in Diversity Award at the first annual conference of the Collaborative Network for Engineering and Computing Diversity (CoNECD). The award recognizes an individual in his or her profession for fewer than 10 years who has actively worked to enhance diversity and inclusion by mentoring, supporting or advocating for the success of historically underserved individuals in engineering or computer science, or for climate and culture change that supports such success.

“I was really excited to receive this award,” says Artis, because it represents “every student, faculty and staff member, teacher and parent I have been fortunate to work with in my career.”

Artis has helped increase diversity in engineering in the areas of outreach, recruitment and retention. She also provided funding for new programs and created a centralized office for STEM diversity and inclusion.

“My contribution to increasing the number of women and people of color in engineering and computing is a result of passionate individuals who share a common vision,” says Artis. “That vision is to open STEM doors and provide access to everyone, regardless of gender, race, ethnicity, socioeconomic background, sexual orientation or any other identities.”

The CoNECD Conference shares that vision and aims to provide a forum for exploring current research and practices to enhance diversity and inclusion of underrepresented groups in the engineering and computing professions.

“There’s still a lot of work to do,” admits Artis, “and I hope others join in so we can continue cultivating more rising stars in the field.”

Student Highlights



AR APP TAKES TOP PRIZE AT BUTTERWORTH PRODUCT DEVELOPMENT COMPETITION

Since 2003, ICS students have been teaming up with their UCI peers to enter their innovative products in the Butterworth Product Development Competition, sponsored by UCI alumnus Paul Butterworth. This year, the cash prizes for the top three teams were higher than ever before, totaling \$20,000, and with 52 teams, composed of 200 students, the competition was steep. Taking first place was Team Zoot (Ting-Wei Lin, Zarina Bahadur and Roger Dalke), which developed an augmented reality (AR) application that helps users locate their lost belongings. Second place went to CrewView (Ke Jing, Christopher Ayuso, Max Collins, Melissa Yutuc, Aparajita Marathe, Fernando Penaloza, Tyler Scrivner and Hannah Tran) for its cross-platform AR/VR application that improves how creative teams collaborate during production processes. Team Breakdown (Ryan Oillataguerre and Brodric Cormie) took third place for its web application that acts as a centralized place for political information. CrewView was also showcased at this year's Ingenuity, the premier student showcase event sponsored by the schools of ICS and engineering. This year's Butterworth judges were Tony Crisp (CRISPx); Brian Dao, B.S. '03 (Alpha Sprouts); Roger Lloyd (Pericia Solutions/Grupo Cognitiva); David Ochi (UCI ANTreprenuer Center); Neil Sahota, B.S. '00 (IBM-Watson Group); and Jojo Seva (NEFCU).



JABBARVAND AWARDED GOOGLE PH.D. FELLOW IN PROGRAMMING TECHNOLOGY, SOFTWARE ENGINEERING

Informatics Ph.D. candidate Reyhaneh Jabbarvand was awarded a 2018 Google Ph.D. Fellowship in programming technology and software engineering. This year, Google named 39 new fellows from North America, Europe and the

Middle East, providing the recipients with financial support and matching them with a Google Research Mentor. The program supports graduate students doing exceptional work in computer science and related disciplines. As a Google Ph.D. Fellow, Jabbarvand will continue the research she has been working on under her adviser, Professor Sam Malek, into mobile app security and energy consumption. Her goal is to reduce energy inefficiency and vulnerability in mobile apps to ultimately improve the user experience.



THREE ICS STUDENTS AWARDED NSF GRADUATE RESEARCH FELLOWSHIPS

Three of the 27 UCI recipients of the 2018 National Science Foundation (NSF) Graduate Research Fellowships were ICS students:

- **Amari Lewis**, a computer science Ph.D. student, is working to produce a cyber-physical paratransit system to provide transportation services for the elderly and disabled. Her goal is to create a cloud-based client-server paratransit system using low-cost materials to increase the accessibility and suitability of these systems for the specified populations.
- **Samantha McDonald**, an informatics Ph.D. student, works with constituent-communication systems in congressional offices. She is collaborating with Congress and partnering organizations to use her research as insight into creating better technology for higher-quality relationships between citizens and policymakers.
- **Arash Nabili**, a computer science Ph.D. student, is focused on developing a framework for cooperative driving of autonomous vehicles. His research involves combining autonomous vehicles' sensors with V2X (vehicle-to-everything) communication to achieve increased safety and traffic throughput.

Chosen from more than 12,000 applications, each of the 2,000 NSF fellows receives a \$34,000 annual stipend and \$12,000 cost-of-education allowance to their graduate institution. The goal is to encourage and support research-

based graduate degrees in the STEM fields. There are also many international research opportunities for fellows to collaborate and grow their professional careers.



MUSTAFA NAMED i3 TEACHING FELLOW

The iSchool Inclusion Institute (i3) named informatics Ph.D. student Mustafa Hussain as one of its 2018 Teaching Fellows for its summer program, comprising two weeks of instruction in research design and programming. i3 is an undergraduate research and leadership development program that prepares students from

underrepresented populations for graduate study and careers in the information sciences. As part of the program, Mustafa taught Python and introduced advanced tools for data management and analysis, including OpenRefine, a useful tool for "cleaning" data prior to analysis; Tableau, which makes certain data visualizations easy to create; and JASP, an open-source tool for statistical analysis. Mustafa is a doctoral student in UCI's Health and Information Lab, where he conducts research involving the mitigation of alert fatigue in clinical decision support.



TWO ICS UNDERGRADUATES HONORED WITH CHANCELLOR'S AWARD OF DISTINCTION

Two ICS undergraduates, Christian Morte and Ayesha Syed, were recipients of the 2018 Chancellor's Award of Distinction. The UCI Alumni Association presented only 49 students from UCI's Class of 2018 with the honor, which recognizes outstanding graduating seniors for their "exceptional academic achievement and commitment to cutting-edge research, leadership and service to UCI."

Morte graduated with a bachelor's in computer science and engineering, and began working as a software engineer resident at Google in September. Syed earned her bachelor's in business information management and is currently working in the IT division for server management at the Los Angeles County Department of Public Works, where she plans to become a business analyst.



WICS WINS TOP STUDENT ORGANIZATION AWARDS

Women in Information and Computer Sciences (WICS) took home two awards at the 38th Annual Anteater Awards in May, including the coveted Most Outstanding Student Organization. Anteater Awards honor UCI's student organizations and their achievements. For the second year in a row, WICS was also recognized as the Most Outstanding Career/Professional Organization, beating out more than 15 other organizations. Notable WICS achievements for this year included: continual growth in its mentorship program; sending 30 students to the Grace Hopper Conference, the largest gathering of women in technology; and hosting its own conference, the Celebration of Women In Computing SoCal (CWIC-SoCal), which attracted 190 participants from all over Southern California.

UCI STUDENTS PLACE SECOND NATIONALLY IN IEEE PROGRAMMING CONTEST

Two dozen UCI computer science and engineering students participated in IEEE's worldwide programming contest IEEEXtreme 11.0, which drew 3,342 teams from around the world. The global online challenge pits teams of IEEE student members, advised and proctored by an IEEE member, against each other to solve a set of programming problems. UCI's team, the 76ers — led by computer science majors Wyte Krongapiradee, Kevin Wang and Pasha Khosravi — placed second in the U.S. and 23rd worldwide. UCI had eight three-person teams competing. The problems they solved spanned a range of topics, including sorting and searching, graph theory, dynamic programming and optimizations.



SKY FARM HELPS UCI CONTINUE ITS WINNING STREAK AT IEEE GAMESIG

UCI's Sky Farm team was awarded first place at IEEE GamesIG 2018, the Intercollegiate Computer Game Showcase of the IEEE special interest group in computer games. The top-10 Southern California finalists competed on May 5, presenting their games to a panel of industry judges, and UCI came out ahead for the fourth year in a row — the fifth time in the competition's seven-year history. The team of computer game science (CGS) students — Christopher Ayuso, Mary Wang, Pafoua Fang and Dong Phan — was a product of the CGS Capstone Project class, taught by Informatics Professor Josh Tanenbaum. As part of the capstone class, the team received guidance from its Blizzard and Amazon Game Studios mentors. Sky Farm, a turn-based game in which the player is a time-traveling farmer who must navigate through obstacles and collect energy crystals to progress through the levels, can be found online at bit.ly/ICS-SkyFarm. The team plans to upload the game on iOS and Android, and has also submitted a grant application for a public games competition to get funding to further develop and publish the app.



CRUZ RECEIVES FIRST LATINO EXCELLENCE AWARD FOR ICS

Statistics Ph.D. candidate Maricela Cruz won the Latino Excellence Award for Information and Computer Sciences. Cruz received the award at the inaugural Latino Excellence and Achievement Dinner (LEAD) held on April 5. The event celebrated research excellence and achievements across all schools on the UCI campus and

recognized key leaders, graduate students, faculty and staff who encourage success in the Latino community at UCI and in Orange County. Cruz's research focuses on statistical methods for assessing the effectiveness of complex healthcare interventions. This interdependency, in which patients, providers, resources and contexts of care interact in dynamic ways to produce various measurable

health outcomes that many times do not align with expectations, makes it difficult to determine the true impact of interventions designed to improve patient healthcare outcomes. The novel statistical methods she's developing can help address this need as well as those in other fields.



HOLBROOK RECEIVES YOUNG INVESTIGATOR AWARD FROM UCI MIND

Statistics Ph.D. student Andrew Holbrook received the 2018 Carl Cotman Young Investigator Award from UCI's Institute for Memory Impairments and Neurological Disorders (MIND) for his exceptional work in theoretical mathematics, probability, statistics, and neuroscience and aging.

The award is given to a senior graduate student or junior postdoctoral student who has made a significant contribution in research on neurological disorders. Holbrook served as a predoctoral trainee at MIND under Dan Gillen, professor and chair of the Department of Statistics, helping design statistical models that leverage non-invasive, MRI-based biomarkers. The models were then used to track patients' memory function as a function of structural brain changes through time. Gillen says that Holbrook "is a rising star who will be able to fuse much of the theory and methodology that will drive machine learning, data science and statistics for applications in neuroscience." In June, Holbrook began a postdoctoral fellowship at UCLA with Biomathematics Professor Marc Suchard.



TSAASAN AWARDED BRYTHON DAVIS FELLOWSHIP FOR SECOND YEAR

Informatics Ph.D. student Marie Tsaasan received the Brython Davis Fellowship for a second year. Funds for the fellowship were donated to the University of California in 1967 by the Brython Parry David Trust to provide financial support for children of U.S. Navy and Marine veterans.

Tsaasan comes from a long line of service members, including her father who served in the U.S. military for 15 years and is now a special education teacher. Her research examines practices of inclusion in playful learning contexts, and she is currently studying how student participation in the Orange County High School Esports League is tied to STEM education and socioemotional learning outcomes. The fellowship helped Tsaasan by covering her resident

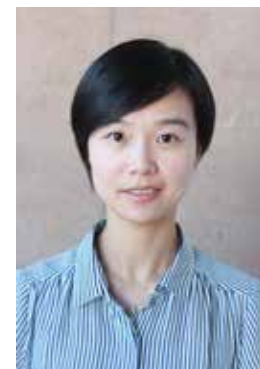
fees for Spring 2018 and by providing a \$6,000 stipend paid over three months.



HAIMSON RECEIVES JAMES HARVEY SCHOLAR AWARD

Informatics Ph.D. candidate Oliver Haimson was the recipient of the 2018 James Harvey Scholar Award. The honor recognizes graduate students who have excelled academically, have a financial need and are studying homosexuality, including but not limited to sociological, medical, political, historical or legal ramifications. Funds for the award

were donated to the University of California in 1991 from Harvey's estate. The award covered Haimson's resident fees for Spring 2018 and provided him with a \$6,000 stipend paid over three months. His research examines how people manage transgender identity disclosures on social media sites. It also looks at the relationship between self-disclosure of a major life transition and emotional well-being and social support. In particular, his dissertation explores how "social technologies can be designed to better enable sensitive self-disclosures during times of life transition, both for transgender and LGBTQ people and the broader population."



ZHU WINS 2017 NEWCOMB GRADUATE AWARD IN STATISTICS

Graduate statistics student Shuying Zhu was the recipient of the 2017 Robert L. Newcomb Memorial Endowed Graduate Award, which aims to provide support to researchers and advance the careers of graduate students in ICS. Zhu previously studied chemical engineering in China, but found statistics to

be "useful and interesting." She is interested in applied statistics and plans to apply for a Ph.D. program to begin a career in academia.

ICS TEAMS MAKE STRONG SHOWING AT ACM ICPC SOCIAL REGIONALS

ICS had five student teams compete at the Southern California Regionals of the 2017 ACM International Collegiate Programming Contest (ICPC) in November 2017, with all teams placing in the top 25, more than any other institution in the region. UCI's top competitor,

team "filter," placed third in the competition, just missing the chance to advance to the world finals. The regional competition involved more than 100 schools. The five ICS teams were coached by graduate student Liangjian Chen and managed by Senior Lecturer Richard Pattis.



ICS ANTEATERS PART OF MEN'S GOLF TEAM CROWNED BIG WEST CHAMPS

Jonathan Young (B.S. in computer science) and Ryan O'Connor (B.S. in business information management and computer science), both recent graduates, were members of UCI men's NCAA Division 1 golf team who were crowned the Big West Champions in May. The team went on to place 11th at the NCAA Pacific Regional. Having worked on an iOS application with the Athletics Networking and Technology Services Department at UCI and developing another iOS application that keeps track of golf statistics, Young hopes to work as a software engineer within the golf industry. O'Connor plans to gain more professional experience and further his growth in the business world.

PARK WINS BEST PAPER AWARD AT DATA MINING CONFERENCE

Computer Science Ph.D. student Jihyun Park was the lead author on a paper that won the Best Paper Award at the 11th Annual International Educational Data Mining Conference (EDM 2018) in July in Buffalo, N.Y. The paper, "Understanding Student Procrastination via Mixture Models," proposes a new approach based on statistical machine learning techniques that can extract and quantify patterns of procrastination observed from student clickstream data in online college courses. In particular, persistent procrastination over the duration of a course was found to be strongly predictive of poorer student outcomes, providing strong evidence that time management is critical for success in online courses. This work is supported by the National Science Foundation as part of the project Investigating Virtual Learning Environments, a five-year collaboration between the UCI School of Education and ICS. The paper was co-authored with Park's adviser, Chancellor's Professor of Computer Science Padhraic Smyth, and fellow researchers from the School of Education.

Educating Future Technology Leaders

ICS launches two new professional graduate programs that will help train students for careers in software engineering and data science.



The Donald Bren School of Information and Computer Sciences (ICS) is set to launch two new professional graduate programs in fall 2019: a master of software engineering (MSWE) and a master of data science (MDS).

The professional MSWE program will prepare students for careers in one of the fastest-growing and highest-paid industries in the United States. “Companies need students who can enter the workforce seamlessly and have deep technical knowledge that allows them to contribute immediately,” says MSWE Faculty Director and Informatics Professor Crista Lopes. “The master of software engineering is designed to provide students with such an education.”

Applications are currently being accepted for the first MSWE cohort, which will consist of approximately 40 students. According to Lopes, the MSWE is looking to attract three types of students: (1) majors in computer science, information systems or informatics who will benefit from an intensive programming and software-development experience before launching their professional careers; (2) majors in science, engineering, arts or humanities who have dabbled in programming and want to branch out into software engineering careers; and (3) working professionals in information systems careers who want to switch to more technical positions. The program’s mandatory internship will also give every student the opportunity to gain experience with a potential employer.

At the completion of the MSWE program, students will be knowledgeable in the underlying principles of software engineering and will have acquired solid practical skills. “With an MSWE degree, graduates will be well prepared to work in the booming software industry in California and beyond,” says Lopes.

The new professional MDS program will meet a growing global need for professionals equipped to work skillfully with big data. UCI is a unique university in that statistics and computer science are in the same school and have many cross-affiliations. “We believe the foundations of data science lie in both statistics and computer science. The need for foundationally talented data scientists and the unique bond we have between statistics and computer science at UCI, make ICS the ideal place to start a professional master of data science program,” says Professor Dan Gillen, chair of the Department of Statistics.

“A professional degree makes sense because currently most data scientists have been trained either in statistics or computer science,” says Gillen. “This new program targets individuals who want to bring together those two disciplines, while also training the next generation of data scientists from a foundational perspective.”

The first MDS cohort will consist of 25 to 50 students, and most will likely have undergraduate training in a STEM field. Students will work with faculty who are nationally and internationally renowned in their discipline, and will

have the opportunity to complete an internship with one of several Orange County-area companies looking to hire new talent.

The two existing professional programs, the master of human-computer interaction and design (MHCID) and the master of computer science (MCS), are both growing and thriving. Students in the MHCID program build a solid foundation in user-experience research and design. Those students who are already working in a related area supplement and augment what they’ve done in their professional lives with the latest research and a deep understanding of the theoretical foundations of the field. Having just begun its third year, the MHCID program has been experiencing steady organic growth. “The vast majority of students who have gone through the program have made some significant advances in their careers since graduation,

whether it be receiving substantial raises or promotions, or changing jobs,” says MHCID Faculty Director and Informatics Professor Gillian Hayes.

The MCS program will graduate 100 students from its first class in December 2018. More than 75 percent of the cohort participated in professional internships, while all of the MCS students received extensive career coaching. “We provide more career-coaching services than we have ever provided in other programs,” says MCS Faculty Director and Computer Science Professor Amelia Regan. “This will be a model for the services we provide for the rest of our graduate student population.” The MCS program also trains students for multiple job options, according to Regan. “We want to be sure if we have another slight tech downturn that our students are prepared to look for jobs not just at the big tech firms, but in other industries as well.”

MCS Graduate Student Spotlight: Aparna China Ramachandra



Aparna China Ramachandra grew up in India, where she studied information science and engineering at the M.S. Ramaiah Institute of Technology in Bangalore. She graduated in the top 5 percent of her class and received the Award of Excellence from Nokia for her work with a group she co-founded in 2011 called Student Nokia Developers, which supports students developing applications for smartphones.

She took her passion for learning to her dream company, Microsoft, where she worked for four years on various R&D teams such as Application Lifecycle Management, Windows Application Development and Azure. During that time, she founded her own successful company, Photokicho, which provides photo booth rentals for various events, ranging from weddings to corporate parties. “I got this idea when I came to the U.S. for the first time a couple of years back,” says China Ramachandra. “I attended a Microsoft event where there was a photo booth; it was a huge

success. People were lining up to take photos and get the prints. So I imported a photo booth from another country to India and started a company with my sister.” China Ramachandra developed the technology required to run the company, including customizable photo booth software, a company website and maintenance support.

China Ramachandra then began to consider going back to school for a graduate degree in computer science. “I had a very satisfying job, but found there was still something missing. I wanted to acquire more skills that would help me in my professional career and take me to the next level,” she says. “When I looked online at the UCI faculty, I was very impressed and really wanted to study here.” During her time in UCI’s master of computer science program, she’s learned more about everything from operating systems to machine learning. “The program has provided me with an in-depth knowledge of all the core computer science subjects,” she explains.

One of China Ramachandra’s goals as a woman working in technology is to help inspire girls to join the field and to close the gap between men and women in leadership roles. “It’s a male-dominated field,” she says. “I think it is up to our generation of female engineers to be the next big thing in IT. This is one of the goals I had in mind when I started the journey of computer science.”

After graduating in December 2018, China Ramachandra plans to pursue a software development position with Etsy that will provide her with challenging projects to test her new knowledge and problem-solving skills. “In the long run, I see myself running an educational institute,” she says, “because I love teaching and I would be really happy having a chance to share my knowledge with others.”

Event Highlights



INGENUITY 2018 RECOGNIZES INFLUENTIAL INDIVIDUALS, CELEBRATES STUDENT INNOVATION

Nearly 250 people gathered at the Beckman Center for Ingenuity 2018, the sixth annual student project showcase representing top student innovations from ICS and the School of Engineering. Technology leader Bruce Horn, Intel Fellow and CTO for the Saffron Technology Group, served as the evening's keynote speaker. Alumnus Art Hitomi (B.S. '96, M.S. '04, Ph.D. '10), CEO and co-founder of Numecent, received this year's ICS Ingenuity Award for his work in the areas of application virtualization and streaming.



ALUMNI CONVERGE UNDER THE STARS AT THE GRIFFITH OBSERVATORY

The schools of ICS, physical sciences and engineering hosted more than 250 alumni, faculty and friends for a special evening at the Griffith Observatory in Los Angeles on Aug. 27. The tri-school alumni event included exclusive access to the observatory's exhibits and its state-of-the-art telescopes. Highlights of the event included a lecture titled "Biography of the Milky Way" by Chair and Professor of UCI Physics and Astronomy James Bullock and a private planetarium show for attendees.

INFORMATICS STUDENT PROJECT SHOWCASE CONTINUES TO GROW

Nineteen projects were on display at the Spring Informatics Student Project Showcase on June 11, with approximately 100 students representing three project courses, the largest showcase to date. Organized by Informatics Lecturer Darren Denenberg and Associate Professor of Teaching Hadar Ziv,

the showcase was supported by nearly 40 corporate project sponsors. For the first time this year, the showcase welcomed augmented and virtual reality theater projects from Informatics 295/190: AR/VR Theater, a new two-quarter pilot course taught by Professor Josh Tanenbaum in collaboration with ICS alumnus Tim Kashani's nonprofit organization Apples and Oranges Arts.

LI ORGANIZES INAUGURAL SOCIAL SOCIAL ANALYTICS WORKSHOP

Computer Science Professor Chen Li helped organize UCI's first SoCal Social Analytics Workshop, which was held in May and sponsored by the UCI Data Science Initiative and the UC Institute for Prediction Technology (UCIPT). The goal of the daylong workshop was to bring together people from different disciplines to exchange ideas regarding social media as a data source and serve as a catalyst for multidisciplinary collaborations.



CPRI DELIVERS ELECTION-HACKING, BLOCKCHAIN EVENTS

UCI's Cybersecurity and Policy Research Institute (CPRI) held a half-day election-hacking conference titled "Can Adversaries Hack Our Elections? Can We Stop Them?" on March 13 that featured an evening keynote address by James Carville, campaign strategist for former President Bill Clinton. CPRI's Executive Director Bryan Cunningham hosted the event, which featured panels on election systems, vulnerabilities and the technology of voting. CPRI also hosted a conference of industry, academic and government leaders on blockchain-based supply chain security and management that explored the promise and perils of blockchain technology for logistics and critical goods in digital and physical hardware. The conference featured special guests Tracy Frost, director of U.S. Department of Defense Manufacturing Technology, and Paul Chang, global blockchain industry lead of distribution and industrial markets at IBM, who delivered keynote addresses.

BALDI HOSTS MACHINE LEARNING SYMPOSIUM

The Southern California Biomedical Imaging and Machine Learning Symposium, co-sponsored by UCI's Institute for Genomics and Bioinformatics (IGB) and NeoGenomics, was

held on June 1, 2018, featuring speakers from all the local UC campuses. Distinguished Computer Science Professor Pierre Baldi, who hosted the event, also gave a talk on "Deep Learning in Biomedical Imaging."



HACKUCI'S LARGE TURNOUT LEADS TO INNOVATIVE CREATIONS

Close to 500 participants filled UCI's Student Center for HackUCI 2018, one of the largest, most successful hackathons held at UC Irvine. For 36 hours, undergraduate and graduate students created 73 projects, with the winning team, HaleCoin, creating a fitness app that lets users earn virtual currency and place bets with real money.

ANNUAL ISR RESEARCH FORUM FOCUSES ON SOFTWARE DEVELOPMENT

The Institute for Software Research held its annual ISR Research Forum: Where Research Meets the Real World on June 8, attracting more than 100 researchers, leaders in industry and technical practitioners for the daylong multidisciplinary event to discuss research and trends in the fields of software development and interactive and collaborative technologies. The program included six short talks by ICS faculty, as well as keynote speeches by Facebook Research's Satish Chandra and Google's Sara Javanmardi (Ph.D. '11).



ALUMNI UNITE IN NYC

In October 2017, ICS alumnus Tim Kashani (B.S. '86) hosted a group of nearly 50 alumni from the schools of ICS, engineering and physical sciences for an evening of networking with the schools' deans in New York City.

2017-18 DISTINGUISHED SPEAKERS

The 2017-18 academic year brought several distinguished speakers to the Donald Bren School of Information and Computer Sciences.

The ICS Distinguished Lecture Series in Information Technology and Society featured:

- **Pamela Samuelson**, Distinguished Professor of law and information at UC Berkeley, who delivered a talk on "What's at Stake in the Oracle v. Google Software Copyright Case?"
- **Jim Kurose**, assistant director of the National Science Foundation's Directorate for Computer and Information Science and Engineering (CISE), who spoke about "An Expanding and Expansive View of Computing."

The Department of Computer Science 2018 Distinguished Lecture Series featured:

- **Manuel Blum**, Bruce Nelson University Professor of Computer Science at Carnegie Mellon University, who delivered a talk on "A Computer Architecture Inspired by Neuroscience, with Suggestions for the Design of a Conscious AI."
- **Jeannette Wing**, Avaneesians Director of the Data Science Institute and professor of computer science at Columbia University, who gave a talk on "Data for Good."
- **Trevor Mudge**, Bredt Family Professor of Computer Science and Engineering from the University of Michigan, Ann Arbor, spoke on "The Explosion in Neural Network Chips."
- **Tom Anderson**, Warren Francis and Wilma Kolm Bradley Chair of the Paul G. Allen School of Computer Science and Engineering at the University of Washington, who gave a talk on "High-Performance Operating Systems in the Data Center."

The Institute for Software Research 2018 ISR Distinguished Speaker Series featured:

- **Miryung Kim**, associate professor of computer science at UCLA, who spoke on "Interactive and Automated Debugging for Big Data Analysis."
- **Xiangyu Zhang**, professor of computer science from Purdue University, who gave a talk on "Dynamic Program Analyses and Their Security Applications."
- **Atanas Rountev**, professor of computer science and engineering at The Ohio State University, who spoke on "Static Analysis for Android: GUIs, Callbacks and Beyond."
- **Anind K. Dey**, professor and dean of the information school at the University of Washington, who gave a talk on "Routines: How Everyday Activities Can Intelligently Inform the Design of Interactive Systems."

To stay informed about upcoming ICS events, please visit ics.uci.edu.



ICS@50 & Beyond

The daylong event on October 16 drew more than 400 attendees who helped celebrate 50 years of research and teaching excellence in UCI's Donald Bren School of Information and Computer Sciences.

“This celebration is not really about the past,” announced Marios Papaefthymiou, the Ted and Janice Smith Family Foundation Dean of the Donald Bren School of Information and Computer Sciences, as he welcomed an enthusiastic crowd to the Beckman Center. “It’s about the future.” He then told the hundreds of alumni, students, founding and current faculty, staff and members of the community who had gathered for the “daylong extravaganza” that by “reflecting on the first half-century of the school and its accomplishments, this event is really meant to foreshadow the next 50 years.”



MAKING A DIFFERENCE

The event kicked off with six TED-style talks focused on how UCI is “making a difference,” with Professor André van der Hoek, chair of the Department of Informatics, acting as moderator.

Professor in Residence of Informatics Mimi Ito introduced the ways in which UCI’s Connected Learning Lab is empowering educators and technology developers to create the “genuinely connected ecosystem of learning” that is key in today’s networked world. In a similar vein, Informatics Professor Constance Steinkuehler talked about UCI’s leadership role in the emerging field of esports and how “games, in the right context, can be an incredible catalyst for learning.”

Turning to cybersecurity, Bryan Cunningham, executive director of the UCI Cybersecurity Policy and Research Institute, noted that because the message for the next decade is “you can never worry too much,” ICS is “staffing up” and taking a “multidisciplinary approach” to tackling critical cybersecurity challenges.

Hal Stern, Chancellor’s Professor of statistics and former ICS dean, spoke of how ICS is “helping the world make sense of its data,” applying data science to everything from healthcare to the justice system to science. Associate Professor of Computer Science Alex Ihler then switched the focus to artificial intelligence (AI), highlighting the massive impact of UCI’s Machine Learning Repository and noting that this is an “exciting time” for AI and machine learning in

education, research and technology.

Wrapping up the TED-style talks was Pierre Baldi, Distinguished Professor of computer science and director of the Institute for Genomics and Bioinformatics, who in discussing AI and bioinformatics asserted that determining “how to get Turing storage in the brain” will be the grand challenge for AI.



THE FIVE TRIBES OF MACHINE LEARNING

Discussions continued as Alex Nicolau, Distinguished Professor and chair of the Department of Computer Science, introduced the lunchtime keynote speaker, ICS alumnus Pedro Domingos (M.S. ’94, Ph.D. ’97). Now a professor of computer science and engineering at the University of Washington, Domingos presented the five tribes of machine learning: symbolists, connectionists, evolutionaries, Bayesians and analogizers.

Domingos admitted that “we are still very far from solving the machine learning problem” but added that once we develop a “universal learner,” it could lead to everything from home robots to a cure for cancer. “We can use machine learning to make the world a better place,” he concluded.



HOW WE GOT HERE

Three one-hour panels followed the lunchtime talk, with the first one being moderated by Computer Science Professor Sandy Irani and serving to highlight how ICS has always been ahead of its time. The three alumni on the

distinguished panel were John Leslie King (B.A. ’72, M.S. ’74, Ph.D. ’77); Lawrence A. Rowe (B.S. ’70, Ph.D. ’76); and ICS’s first graduate student, Marsha Drapkin Hopwood (Ph.D. ’74). Joining them were Dick Taylor, Chancellor’s Professor emeritus of informatics; Fred Tonge, a member of the founding faculty of ICS; and Debra Richardson, founding dean of ICS. In discussing ideas upon which the school was founded, the panelists emphasized building a strong faculty, viewing students as full partners and recognizing social impact.



INDUSTRY AND ENTREPRENEURSHIP

The second panel focused on how ICS has shaped the world around us. Moderator Pat Helland ’76, a software architect at Salesforce, opened the discussion by asserting that the School of ICS “gave me a passion.”

He was joined by Professor of Computer Science and Levyx Co-Founder Tony Givargis and four accomplished alumni: Andreas Gal (Ph.D. ’06), founder and CEO of Silk Labs; Owen O’Malley (M.S. ’89, Ph.D. ’96), co-founder and technical fellow of Hortonworks; Sandy Smart-Ashburn (B.S. ’87), AVP of technology at AT&T; and Kevin Thompson (M.S. ’88), vice president of marketplace engineering at Uber. A few takeaways from the discussion were the importance of finding your passion, learning how to learn, and understanding your customers and the many roles of business.



PREPARING FOR THE FUTURE

Guided by moderator Dan Gillen, professor and chair of the Department of Statistics, the third panel considered

what lies ahead. The diverse group ranged from statistics Ph.D. candidate Michelle Nuño to alumni such as Dan Russell (B.S. ’77) of Google and LouAnne Boyd (Ph.D. ’18), an assistant professor of computer science at Chapman University. Other academics included Domingos as well as Jonathan Chen (Ph.D. ’09), an assistant professor at Stanford University, and UCI’s Sameer Singh, assistant professor of computer science. Rounding out the panel was Tim Kashani (B.S. ’86), co-founder of Apples and Oranges Studios and IT Mentors.

The panel touched on everything from AI in the workforce to the dimensions of diversity to self-driving cars and ethics. As Domingos noted, “Maybe the best things we will learn from machine learning will be what it forces us to learn about ourselves.”



FROM UCI TO IPO

Vincent Steckler (B.S. ’80), CEO of Avast Software, delivered the closing keynote, which was followed by a showcase of 14 research projects highlighting ICS work in all of the areas discussed throughout the day.

When introducing Steckler, UCI Chancellor Howard Gillman praised ICS for its central role on the UCI campus. “It’s hard to imagine any cutting-edge research project here at UCI that does not draw upon information and computer sciences.” He continued, “The expertise of the Bren School’s computer scientists, informatics experts and statisticians are central to us as we move forward to look at climate change, sustainability, education, art, business, entertainment, biological systems and any of a myriad other set of challenges.”

Steckler then took the stage, comparing the challenges of 1968 to those of 2018, and outlining his journey from studying at UCI to taking Avast Software public this past spring as one of the five largest tech IPOs of all time in London. Acknowledging that ICS paved the way for his success, he explained that universities “are at the core of social change” and “provide a path for upward mobility.” He concluded by giving “many, many thanks to UCI for the opportunities that the education opened up for me.”

50th Anniversary Highlights



An Interdisciplinary Pioneer

Hall of Fame alumna Marsha Drapkin Hopwood, Ph.D. '74, has enjoyed the journey that turned her into a champion for ICS and diversity in STEM.



Marsha Drapkin Hopwood addresses graduating students at the 2018 ICS commencement ceremony.

Marsha Drapkin Hopwood received her undergraduate degree in mathematics from Stanford University before becoming UCI's first information and computer science graduate student when ICS was first formally established as a department, completing her Ph.D. in 1974. "At UCI, even though it was a small program, I met many pioneers in the computing field who were here as faculty or speakers," she says.

Hopwood left UCI for the RAND Corp. in Santa Monica, Calif., primarily working in the health program on a variety of National Institutes of Health (NIH) projects related to clinical research and trials. While most of the projects were the cross-discipline analytical studies that are typically done at RAND, one unusual project that took place in the mid-1970s developed and evaluated a prototype computer system to support small-scale clinical research. The project began when the Division of Research Resources at the NIH received requests from clinical research centers nationwide for computer assistance.

"This was before personal computers, and these centers were part of major medical centers that had mainframe computers used for large-scale clinical trials," says Hopwood. "But they didn't have staff or computer systems that could help medical people with small-scale, preliminary research." So Hopwood was part of a team that interviewed researchers informally and formally

to understand their goals and put together a prototype system, which eventually led to the NIH contracting to implement the system on a wider scale.

Hopwood left RAND for TRW (now Northrop Grumman), where she worked on strategic planning and project management, and also served as CIO for one of the divisions at Space Park in Redondo Beach, Calif. Hopwood and her team were also responsible for introducing personal computers and PC standards to Space Park, selecting and implementing a common email system, and developing standards for connectivity among a disparate collection of computing tools. In an "every man for himself" environment, where engineers often cared more about individual computing requirements than those of their group as a whole, Hopwood and her team picked a system, developed an agreement with engineers on what equipment to use, and moved forward, implementing a system that was successfully used for many years.

Hopwood was also one of the inaugural ICS Hall of Fame inductees and has remained a partner and champion for ICS, especially in the area of diversity in the STEM fields. "As an undergraduate, I wasn't welcome in engineering; in the aerospace environment, it was also a battle," says Hopwood. "The assumption in a new group was often that I was an entry-level employee. ICS was not like that. I benefited a lot from that environment and wanted to pass some of that on. I hope I can keep the attitude we had growing."

In 2018, Hopwood was the featured speaker at the ICS undergraduate and master's commencement ceremony. She told students they should take the interdisciplinary curiosity so prevalent at UCI with them out into the world and their careers, and rather than focus on the specifics of ever-changing technologies, to focus instead on problem-solving skills. "You have these skills and they can take you anywhere you want to go," Hopwood told the graduating students.

Now retired, Hopwood enjoys ballroom and West Coast swing dancing, and plays in a percussion ensemble and concert band through a local community college. She's also a lettered athlete, having played on the intercollegiate bowling team as an undergraduate. Once Title IX was passed, Stanford decided to recognize past female athletes. So one day, to her surprise, Hopwood received a note awarding her a varsity letter. "It made me laugh, and it's a great story," she says with a smile. "I wasn't a great bowler, and my best scores always came after a tough exam." 🎯



From left to right: Sivan Mahadevan '85, Howard Gersh '91, Sandy Smart-Ashburn '87 and ICS Dean Marios Papaefthymiou.

2018 HALL OF FAME

Now in its third year, the Hall of Fame once again honored alumni from the Donald Bren School of Information and Computer Sciences who have made a significant impact in their profession or otherwise brought distinction to their alma mater. In March 2018, ICS inducted four more alumni during a ceremony at the Lyon Air Museum in Santa Ana, Calif. For more information on the ICS Hall of Fame or to nominate someone, visit tech.uci.edu/halloffame.

HOWARD GERSH

B.S. '91, Information and Computer Science

With an extensive background in visual effects and animation, Gersh's work has appeared in more than 24 major motion pictures, including the "Star Wars," "Pirates of the Caribbean" and "Harry Potter" franchises. Most recently, he worked at ImageMovers Digital (a Disney company), on the CG feature, "Mars Needs Moms" and was part of the lighting team in Disney's "A Christmas Carol." During his tenure at George Lucas' visual effects division, Industrial Light + Magic (ILM), Gersh worked on "Forrest Gump" and lighted the photorealistic Davy Jones character and his crew of computer-generated pirates in "Pirates of the Caribbean." Prior to ILM, Gersh worked at Rhythm & Hues Studios in Hollywood, mastering software and computer-graphics production techniques and working on a variety of television spots, including the Coca-Cola polar bear campaign. In addition, Gersh's personal artwork has been exhibited at the Museum of American Illustration in New York City and at various art shows throughout San Francisco, and has been published in leading illustration annuals. He has created artwork for private, corporate and nonprofit clients. Gersh teaches virtual reality, animation and digital visual effects to high school students at Marin School of the Arts. He also teaches at Academy of Art University, and he and his wife started a company, Enriching U, to inspire kids with afterschool programs and summer camps in a variety of digital and visual subjects. He resides in the San Francisco Bay Area with his wife and three sons.

SIVAN MAHADEVAN

B.S. '85, Information and Computer Science

Mahadevan, who has more than 25 years of financial market experience, worked for New York investment bank Morgan Stanley for 19 years and Salomon Brothers for eight years. He currently is managing director in Morgan Stanley's risk management department, where he leads a team of 50 professionals focused on model risk management and financial regulation implementation covering broad areas of institutional securities, risk

modeling and capital planning. Mahadevan has been a highly ranked strategist in Institutional Investor's annual Fixed Income Research survey for 12 years, and also has led research efforts covering equity derivatives strategy and quantitative analysis. At both banks, he worked closely with institutional investors and regulators on investment strategy, market insights, research frameworks, bespoke analyses and risk management. Mahadevan has a unique background, including undergraduate and graduate education in computer science at the University of California and Columbia University, and was a member of the technical staff at Bell Laboratories before joining the financial industry.

SANDY SMART-ASHBURN

B.S. '87, Information and Computer Science

Smart-Ashburn is an AVP of technology at AT&T, where she leads a software-delivery organization responsible for personalization/machine learning technologies and web-based OTT streaming. Prior to AT&T, she held several leadership roles at DIRECTV, including director of middleware development, senior director of enterprise integration and offers, and VP of development, where she was responsible for technical development and delivery of the company's suite of IT applications. Smart-Ashburn started her career at Hughes Aircraft Co. as a software engineer responsible for designing, programming and deploying relational database applications supporting the B2 radar systems. An active alumna who serves on the UCI Diversity Committee for ICS and engineering and on the ICS Leadership Council, Smart-Ashburn has been an active participant and advocate for the Undergraduate Mentorship Program in both schools.

VINCE STECKLER

B.S. '80, Information and Computer Science

Steckler, Avast Software's CEO and one of its directors, helped transform the company from a sub-\$20 million regional business into a \$800 million full-service global security provider seeking to make the internet safe from cyberattacks. Prior to joining Avast in 2009, Steckler was senior vice president of worldwide consumer sales at Symantec Corp., which he joined in 2000 as vice president of public sector business. In that role, he started Symantec's business of serving U.S. local, state and federal governments. He also held the position of vice president for Asia/Pacific and Japan, responsible for all enterprise and consumer business in that region. Before joining Symantec, Steckler had 20 years of experience in software development, systems analysis and engineering, project management and business development. In addition to his ICS degree, Steckler earned a B.S. in mathematics at UCI. (Read his spotlight on page 46.)

High-Speed Big-Data Processing for the Masses

Computer Science Professor and Levyx Co-Founder Tony Givargis bridges the gap not only between hardware and software, but also between academia and industry.



The Levyx co-founders with a team of engineers who are UCI alumni: (from left, back row) Steffen Peter, Reza Sadri, Tony Givargis and Nathan Chan; (front row) Christopher Rigmaiden, Fang Zhang and Siddharth Choudhuri.

A decade ago, Computer Science Professor Tony Givargis received a phone call from Reza Sadri, CTO of a local company, about one of his Ph.D. students. “He called me for a reference check,” says Givargis of Sadri, recalling how the two co-founders of the enterprise big-data software company Levyx first met. In subsequent years, as Givargis performed consulting work for Sadri, the two became increasingly aligned in their views of shifting hardware and software trends.

“In the ’80s and ’90s, the problem was storage capacity, while in the 2000s, it shifted to throughput,” explains Givargis, who has been at UCI since 2001, researching and teaching in the areas of embedded systems and software. “By the 2010s, with the capacity and throughput problems largely resolved, the metric of interest became latency.” In other words, the critical metric for a variety of industries became the round-trip time required to store and retrieve a piece of information. “Latency is a key enabler in many of the emerging large-scale big-data use cases, including real-time analytics, self-driving and connected cars, healthcare, finance, artificial intelligence and cybersecurity, to name just a few areas,” he says.

So, in 2013, Givargis and Sadri started toying with the idea of starting a company focused on reinventing the system software stack to make big-data processing more accessible. Later that year, they founded Levyx (*levyx.com*). The goal, notes Givargis, was to “bridge the gap between trends in hardware — many core systems having flash-

based solid state drives (SSDs) — and emerging big-data applications such as artificial intelligence, machine learning and IoT.”

Five years later, Levyx’s system software stack is in production and enabling low-latency access to large datasets that reside on new server platforms, providing storage in the form of SSDs or other non-volatile memories. “Our data stack can manage very large datasets (often measured in petabytes and scaling to exabytes) in dense distributed clusters, resolving some of the critical challenges related to digesting large volumes of data in real time and running queries against the data with very low latencies,” he says.

Levyx also offers a framework for offloading computing and analytics tasks using just-in-time compilation techniques. In July, it introduced Radon, engineered for use cases requiring 1,000 or more physical nodes — such as those intended for use at data centers for connected cars, cybersecurity, IoT and risk management.

The 25-person company currently employs 15 top-tier and highly vetted engineers who are experts in various disciplines, including advanced database design, embedded systems, system software and flash architecture, to name a few. Additionally, Levyx has employed four to five summer interns every year for the past three years, the majority of whom have been recruited from UCI. “Every winter or spring, I invite my top CS 145 embedded software students to apply to Levyx, and I write a strong letter of recommendation for them,” says Givargis. “Some of these interns have joined as full-time engineers who are helping shape some of most innovative products, which has been a tremendous win for Levyx and a great opportunity for our students.”

There’s clearly no question as to which title — Levyx CTO/co-founder or UCI professor — holds more weight for Givargis. “I love my job as a professor,” he says, noting that he has continued to maintain his full teaching and research load at UCI. “My relationship with Levyx has been on a consulting basis,” he says, adding that building a startup — and tackling challenges related to everything from fundraising and product design to team building and sales and marketing — has been a “tremendous learning experience.”

The most important part of the experience, however, has been learning how to bridge the gap between research and relevant applications. “The real value has been the connections to industry that I’ve made and the appreciation that I now have for solving real-world problems,” says Givargis. “I hope to leverage these in my research at UCI.”

Dean’s Leadership Council

The Dean’s Leadership Council is an advisory board of executive-level leaders who helps advance our research, teaching and public service goals by strengthening the school’s ties to industry and the community. For more information about the Dean’s Leadership Council, please contact crupp@uci.edu or (949) 824-5094.

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PARTNERING FOR SUCCESS

SendGrid is entering its second year of collaboration with UCI for its informatics capstone classes.



Dana Sherrell and Vinh Lam of SendGrid.

During the 2017-18 academic year, UCI began an exciting collaboration with new corporate partner SendGrid, a digital communications platform serving companies such as Uber, Yelp, Spotify and Airbnb. SendGrid (sendgrid.com) sponsored two informatics project classes, a two-quarter capstone class taught by Associate Professor of Teaching Hadar Ziv and a one-quarter class taught by Lecturer Emily Navarro.

Dana Sherrell, senior manager of software engineering at SendGrid, visited both classes on campus and pitched the project to students who responded enthusiastically. Students involved in the project visited SendGrid in person for two to three hours a week. Sherrell also met with them weekly over Google Hangout to set goals for the meet up, and discuss hurdles and questions. At on-site meetings, students demoed their progress and received live feedback from SendGrid team members on how to pivot and what needed to be updated. "Students had to learn multiple new technologies to bring together the proof of concept they did for us," says Sherrell. "They appreciated the exposure to new challenges and a various array of things they hadn't tried before."

Vinh Lam, a recent UCI alumnus who worked on a two-quarter project with SendGrid through Ziv's class, was hired by the company as a software engineer just after graduating from UCI in the spring. "I think it was really helpful to jumpstart my career to be able to take part in a project that involved tools that a lot of the head companies now use," says Lam. "It's one thing to work on class assignments where you have super-defined requirements, and where everything has been thoroughly thought out and

all you have to do is apply what you learned in class. This was different, because with this capstone project we had a company giving the students a challenge that forced us to look at our skills in a more practical way. We'd think: 'This is what we need to get done. How do we get there?' You learn a lot more that way."

The collaboration was just as beneficial to SendGrid, making it a true win-win. Mentoring UCI students over the course of several months gave SendGrid developers good career-path development experience and a chance to increase their own communication, teaching and leadership skills. SendGrid was also thrilled that the collaboration resulted in the chance to hire Lam.

"Most companies would love to be able to have more exposure to a potential candidate or set of candidates before they make a decision as to whether or not it's a good fit on both sides," explains Sherrell. "You want a candidate to get good exposure to who you are as a company as well. You try to do that during the interview process but it's such a limited time window. So for them to have the opportunity to come in and work with us for a bit really improves the chances of a successful relationship. Both sides are able to make a much better, more informed decision. For that reason, I really like the process. I'm excited we are a new partnership, and I look forward to being able to continue it, and hopefully get more future 'Griders' from it."

For the 2018-19 academic year, SendGrid plans to work again with students in informatics project courses. "I've already broken down the project to pitch it to the students," Sherrell says with a smile. 🌟

Corporate Partners

The Corporate Partners Program allows companies to grow their relationships with the ICS community to reach their strategic goals, while also being highly visible collaborators in moving the ICS mission forward. For more information about the Corporate Partners Program, please contact crupp@uci.edu or (949) 824-5094.



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ICS alumnus Vince Steckler, B.S. '80, who recently turned Avast into one of London's largest tech IPOs, understands the importance of giving back.

Inducted into the Donald Bren School of Information and Computer Sciences Hall of Fame in March 2018, Vince Steckler was unable to accept his award at the ceremony along with this year's other inductees. Instead, the UCI graduate with bachelor's degrees in both mathematics and computer science was preparing his company, Avast, for its initial public offering on the London Stock Exchange.

Steckler, who was senior vice president of worldwide consumer sales at Symantec before becoming CEO of security giant Avast, says that when he first learned about the company, it was "a diamond in the rough." When he joined Avast in 2009, the online security company had about 40 employees and sales of under \$20 million a year. Avast has since grown to more than 1,700 employees and over \$800 million in sales, and its security software is stopping 2 billion attacks per month. When the company went public in May 2018, it was one of the five largest tech IPOs of all time in London and the largest in Europe this year. Steckler took time out of his world travels to answer some questions about his rise to success and the importance of giving back.

Did you always have an interest in security?

My first job was very much related to computer security. I was doing security and safety analysis of nuclear weapons software in Los Angeles, leading the software safety analysis for the deployment of the Ground Launched Cruise Missile in Europe. Then, after doing a few other things, I ran a resale business inside the same company and was selling software, mostly Netscape and Oracle, to the federal government. I did that for many years before Symantec hired me to start up their government business. Eventually I moved to Asia and ran the Asia and Japan divisions of Symantec, and in 2000 I took over its consumer business. I did that until the 22-hour commute got to be too much.

How did you get started at Avast?

I knew of them but didn't know very much. I learned more from the gentleman they wanted to hire as their CEO, but he was retired and didn't want to go back to work. He was my ex-boss from Symantec, so he put me in touch with them. We hit it off, and I took over the company.

Avast was fairly well known in the immediate region and by geeks around the world, but it wasn't really big at the time. When I took over, it did maybe \$15-\$20 million in business; now it does over \$800 million. We took it from a very small company to the world's most popular security product. When we went public in May on the London Stock Exchange, we floated just under \$1 billion.



Vince Steckler (center) at the London Stock Exchange for the initial public offering of Avast in May 2018.

How did your ICS education help along the way?

It helped a lot. In 1980, computer science was so different from what it is now. We had to learn compilers, and one of the first things I did in my job was build a compiler. We had to build operating systems, because these were control systems that weren't using commercial-off-the-shelf software; a lot of it was custom built. So, much of the theory I learned at UCI about how compilers work, how data structures work and how operating systems work gave me the knowledge to build these things. At the time, the computer science curriculum at UCI didn't include programming, but you can learn things like that on your own. It's the knowledge gained in how to solve problems that is most important in real life.

Did you have a favorite class?

The AI classes were by far the most interesting. UCI was a pretty big AI school — not in terms of machine learning, but following on from Marvin Minsky's work at MIT. AI was a lot more primitive then. It used languages called SNOBOL and LISP, and the computer that was here was a DEC-10.


But security is heavily AI-related, and that goes back many years. The current AI in vogue is machine learning. What we have for our security at Avast is a massive installed base. Our software runs on 520 million different computers and mobile phones around the world, so from those, we gather a massive amount of data, and that data goes into our cloud. We run about 11,000 servers in the cloud and, at any given time, 60 million of our users are connected to our cloud. It's on a scale that no one else has, but it's that massive amount of user data that really provides the raw information to figure out what's safe and what isn't safe on the internet.

"UCI has built a great computer science program, and I wouldn't be where I am if it wasn't for UCI."

Can you tell us about Avast's charitable foundation?

Avast is based in the Czech Republic and has deep roots there. About six or seven years ago, we started the Avast Foundation, a charitable organization that receives a percentage of our profits. Unlike the foundations of most tech companies, which donate equipment or scholarships for computer science students, our foundation looks at what's missing in the country's social network. So a big focus has been on palliative care, which isn't something you usually see a tech company spending money on, but we've been successful in addressing this unfilled need in the country. We ran a bunch of pilot programs to show how to effectively implement end-of-life care, and this year the government stepped in to take care of a lot of the funding. We also focus on early childhood care as well as the arts, because the Czech Republic is a very artistic, very musical country. So we don't really do much with technology, but the foundation is giving back to society as a whole.

And what motivates you to give back to UCI?

The recognition that everyone needs to give back to help and guide others. UCI has built a great computer science program, and I wouldn't be where I am if it wasn't for UCI. 

NEXUS OF KNOWLEDGE

The new Interdisciplinary Science and Engineering Building, which broke ground in July, will foster collaborative research in computing, engineering and physical sciences.



The \$120 million Interdisciplinary Science and Engineering Building – shown here in an architectural rendering – will accommodate more than 50 faculty members and hundreds of students.

Photo: UCI Design and Construction Services



Digging in at the groundbreaking ceremony on July 16 are UCI deans and officials (from left): Brian Pratt, Greg Washington, Enrique Lavernia, Pramod Khargonekar, Henry Samueli, Howard Gillman, Meredith Michaels, Ken Janda, Marios Papaefthymiou and Brian Hervey.

Construction on UCI's newest multidisciplinary research building is officially underway after a July 16 groundbreaking ceremony that was attended by nearly 200 faculty, staff, corporate partners and community members.


Supported by a transformative \$30 million gift from the Samueli Foundation, coupled with \$50 million in state funds and \$40 million in UCI funds, the Interdisciplinary Science and Engineering Building (ISEB) will comprise more than 200,000 square feet of research, office and meeting space. Slated to be one of the largest interdisciplinary research buildings west of the Rocky Mountains, when completed in late 2020, ISEB will bring together faculty, students and staff from UCI's Henry Samueli School of Engineering, School of Physical Sciences and Donald Bren School of Information and Computer Sciences (ICS). They'll be able to undertake transdisciplinary projects in line with two major themes: biomedicine for human health, and energy use and the environment.

Smart-grid technologies, transportation systems, energy storage, renewable energy technology, greenhouse-gas-reduction approaches and zero-carbon mobility systems are among the research endeavors that will occupy the new space. "The overarching vision with this exciting facility is to provide spaces that foster the convergent integration of knowledge, tools, techniques and, most importantly, modes of thinking from faculty, students and staff across

these disciplines," says Pramod Khargonekar, UCI's vice chancellor of research. "Co-locating faculty and students from three schools in the same building is a major next step as we build on our rich tradition of interdisciplinary research."

Besides expanding the scope of campus research and student education, ISEB will also enhance UCI's ability to find solutions to complex global and regional problems. Potential ideas include developing chemical and material sensors to better diagnose and treat cancers; using big data, environmental engineering and organic chemistry to improve water supply or solar energy; testing driverless vehicles; and having cybersecurity coders and mathematicians collaborate on military or medical challenges.

The engineering school will oversee about half the space, the physical sciences school about a third, and ICS about a sixth – with graduate students from all three schools working together in laboratories, offices and meeting rooms.

"Computer science plays a central role in the transformation of our daily lives, and through this new building, ICS will be able to physically be in the center of all this activity, surrounded by engineers, physical scientists, chemists, physicists and mathematicians," says ICS Dean Marios Papaefthymiou. "I look forward to all of the research activities that will be happening in this new building." 

Join the Ring Road Society

Tackling today's societal grand challenges requires innovative approaches from multiple disciplines.

UCI has a long history of nurturing interdisciplinary research collaborations; from its very beginning, the campus's Ring Road design has provided a circle of schools facing each other. Now, the new Interdisciplinary Science and Engineering Building (ISEB) brings together researchers from three schools who will continue this tradition by working together to find advanced solutions to complex regional and global problems.

UCI alumni and friends who want to be part of this effort from the ground up can join the Ring Road Society. A tax-

deductible gift of \$10,000 to \$50,000 in support of ISEB includes membership in an exclusive group of visionaries who believe in the Anteater interdisciplinary tradition. Your gift helps UCI maintain its position at the forefront of scientific and technological research, and ensures that a world-class science and engineering education remains within reach for our students, regardless of background or means. Your support also benefits the university's ongoing effort to attract the best and brightest research talent to help address today's global challenges.

For more information on giving opportunities, please contact crupp@uci.edu or (949) 824-5094.

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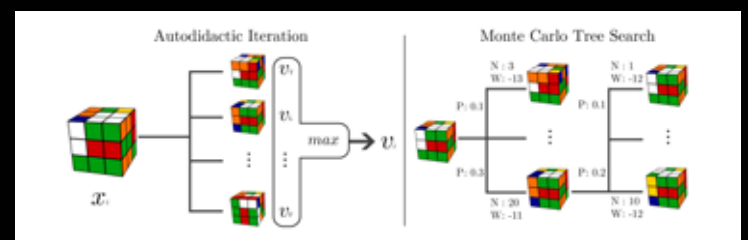


FSC PRINTER TO PLACE

CRACKING THE CUBE



Working with Distinguished Professor of Computer Science Pierre Baldi, Ph.D. students Stephen McAleer and Forest Agostinelli, along with senior Alex Shmakov, have advanced machine learning with the development of “Autodidactic Iteration,” a novel reinforcement learning algorithm that can solve the Rubik’s Cube without human assistance. Their solution uses curriculum learning to let the algorithm “teach itself” which cubes are closer to being solved by developing a curriculum of cubes, starting from the solved cube. Once the network has been trained, Monte Carlo Tree Search is used to solve the puzzle.



“We are very excited about this because it uses pure reinforcement learning to solve a combinatorial optimization problem,” says McAleer. “By getting rid of the need for human data, we hope that pure reinforcement learning approaches will be able to solve domains that are too complex for humans to think about.”

The team is extending its research to other scientific applications such as working on predicting the tertiary structure of proteins. “I am extremely optimistic about applications of AI in science and technology,” notes McAleer, adding that advancements in these areas are, after all, “how society moves forward.”

Read the full story online: bit.ly/ICS-Rcube