

Transmission

News from the College of Natural Sciences & Mathematics

CAPTIVATED BY A CAREER THAT “ROCKS” | p. 4

COLLEGE NEWS | p. 6

NSM DONOR HONOR ROLL | p. 7



PREPARING THE NEXT GENERATION OF DATA SCIENTISTS

What does a student conducting research for Google have in common with a graduate researcher in a perovskite research group who’s also taking part in a statistical consulting project for a pharmaceutical company? They’re both Cal State Fullerton students participating in exciting, interdisciplinary research underway at the Center for Computational and Applied Mathematics (CCAM).

“The underlying theme of all projects at CCAM is computation,” explains Sam Behseta, director of CCAM and professor of mathematics.

“Massive amounts of increasingly complicated data are being generated across every field, and the computational tools to analyze this data are becoming more complex. Without good modeling approaches and a deep understanding of how to effectively utilize these tools, this data is hard to use. Students learning these computational methods as part of their scientific studies become better prepared and more appealing job candidates.”

There are more than 2.7 million job openings for data scientists in the United States, and that number is expected to grow. Recognizing that, CCAM is helping ensure the Cal State Fullerton students who come through its labs understand modeling and can write efficient code and algorithms. Whether they’re heading straight into industry or pursuing advanced degrees, graduates with those skills are in high demand.

Even before they graduate, students are taking advantage of unique opportunities available to them because of this training.

Juan Cabrera, a senior mathematics major and computer science minor, was accepted to the Computer Science Research Mentorship Program at Google.

“I am working with Google to develop a research project with a focus on machine learning,” says Cabrera. “Google is also sponsoring my attendance at the Thirty-Fourth AAAI Conference on Artificial Intelligence in New York, and in June I will be presenting my research at Google headquarters in Mountain View.”

CONTINUED ON PAGE 2 ›

MESSAGE FROM THE DEAN:

Meeting Society's Needs With Science & Mathematics



In the College of Natural Sciences & Mathematics, we educate our students to be globally engaged citizens and problem-solvers, ready to take on society's great challenges and opportunities. In this issue, you'll learn how our faculty continue to meet market demands with focused

mentorship, the development of new research centers, and industry partnerships focused on emerging technologies.

The increasing reliance on data analysis and artificial intelligence across all industries is fueling an ever-growing demand for data science professionals. In response to this undeniable area of opportunity, we're proud of the work our Center for Computational and Applied Mathematics (CCAM) is doing to facilitate research, education, and outreach in computational mathematics and science through interdisciplinary collaboration.

CCAM's emerging Corporate Partners Program will allow students to work directly with local industries, further enhancing career readiness.

In the physical realm, complex earthquakes like the one we saw at Ridgecrest last year show the ever-evolving need for geological expertise to enhance response and recovery and develop better prediction and protection strategies. Geologists prepared through our program, including our Geological Science Alumni of the Year Janis Hernandez, are tackling challenges like these every day. We're committed to continually inspiring and preparing our students to unlock the mysteries of the natural world – and use that knowledge to save and improve lives.

None of this would be possible without our exceptionally talented and dedicated faculty and our incredible network of alumni, donors, industry partners, and community members. So thank you, as always, for your ongoing support.

Marie Johnson, Ph.D.

Dean, College of Natural Sciences & Mathematics

CONTINUED FROM PAGE 1 ›

An aspiring data scientist, Cabrera says seminars sponsored by CCAM in python and R have been very useful in his research and career preparation, and he has appreciated the support and mentorship from Behseta and Allyson Fry-Petit, assistant professor of analytical and materials chemistry. He is working with them on machine learning for perovskite classification and prediction.

"I believe it is important for every institution to have collaborative efforts to support students in these cutting-edge data science endeavors," Cabrera says.

ENHANCING CORPORATE PARTNERSHIPS

Chanel Lee, a second-year applied mathematics master's student, is a member of the perovskite research group and is also involved in a statistical consulting project for a pharmaceutical company.

"Real-world experience is valuable to all students, whether we're going into academia or the job market," says Lee, who plans to become a college professor and is currently applying to doctoral programs. "This type of research and consulting is an opportunity to work with real data – which tends to be messy. I've learned more about the pharmaceutical industry and how its data operates."

This work is part of CCAM's new Statistical Consulting Unit, part of its Corporate Partners Program.

"We are looking to partner with local companies to provide students hands-on learning opportunities that prepare them for the workforce,

"I believe it is important for every institution to have collaborative efforts to support students in these cutting-edge data science endeavors."

Juan Cabrera, senior mathematics major and computer science minor

build the capacity of CCAM, and fuel the pipeline of qualified talent," says Behseta.

CCAM offers three tiers of corporate partnership opportunities, based on a company's desired level of engagement with students and faculty on projects related to statistics or data analytics.

A corporate partner may choose to participate in an undergraduate class project, through which CCAM will partner with the organization to develop a scope of work that aligns with the educational outcomes of the class, while providing mentoring and networking opportunities for students. Or, a company may partner with CCAM for a student team industry project, where CCAM will build a team of undergraduate and/or graduate students who will work on a project. A corporate partner can also choose a faculty research project, for which expert CCAM faculty will lead highly complex or technical research projects issued by the company.



Sam Behseta, professor of mathematics, Allyson Fry-Petit, assistant professor of chemistry and biochemistry, and their team of undergraduate students are using machine learning to better understand materials used to make solar panels and predict how they will perform.

THE CASE FOR EMPHASIS ON DATA SCIENCE AND STATISTICAL CONSULTING

2.7 million+

jobs are currently available for data scientists in the United States.

The Bureau of Labor Statistics projects that employment of statisticians alone will grow **34%** through **2024**, compared to 7% for other occupations.



78% of employers who have hired a data analysis position in the last 12 months reported they had difficulty recruiting qualified candidates.

NSM's Master of Statistics program is the **largest graduate program in the college.**



Corporate partners that have worked with CCAM faculty and/or students in the past include the RAND Corporation, Cox Communications, Spectrum Pharmaceuticals, L3 Technologies, Black Swan Data, and Black Forest Seven. CCAM's Corporate Partners' Statistical Consulting program is supervised by internationally recognized statisticians with expertise in Bayesian statistics, statistical and machine learning, design of experiments, and computational statistics. The program includes applied mathematics and statistics graduate students as well as undergraduate students majoring in mathematics. CCAM researchers write code in Python, R, C, SAS, and MATLAB, and they have access to a major computing cluster right in the CCAM facility.

"Our vision is to get students to work directly on industry projects that are current, important, and real, with well-defined deadlines, deliverables, reports, and presentations," says Behseta. "That way, students get

to experience all activities that go into creating research and presenting it in a comprehensive and understandable way."

A RELIABLE RESOURCE FOR STUDENTS AND SOCIETY

Behseta says that the expanded Corporate Partners Program's diverse project opportunities will allow CCAM to increase research collaborations throughout the College of Natural Sciences & Mathematics and the University.

CCAM has already partnered with the local chapter of the American Statistical Association and UCLA's Statistical Consulting Group to ensure it is offering the most effective program to corporate collaborators.

"Our mission is to be able to provide computational support to anyone who needs it at any given moment," says Behseta. "Along those lines, we're reaching out to

all new hires to encourage them to be part of our interdisciplinary research community."

The CCAM-maintained computer cluster continues to be constantly in demand, and Behseta says CCAM plans to eventually expand its physical infrastructure – adding another cluster or two – as well as its educational seminars and workshops.

"I think what distinguishes CCAM, and Cal State Fullerton, is that students' research supervisors truly become their mentors," he adds. "Students enjoy hanging out in the lab. They look to their professors as role models, learning everything from scientific foundations, to how to put together a manuscript, to how to handle balancing their personal and professional life. This is a new phase for our center, and we're very excited that our college and dean are so supportive of CCAM and its goals." •



ALUMNI PROFILE

Janis Hernandez (BS '95): CAPTIVATED BY A CAREER THAT “ROCKS”

“My applied geology coursework prepared me well for my career in both consulting geology and as an engineering geologist for the state.”

Janis Hernandez (BS '95)

Janis Hernandez has loved the outdoors since the camping trips of her childhood. And when she took a geology course in the early '90s, she realized she had found her calling.

“I could not stop thinking about rocks after that class, and I wondered, ‘Is there something wrong with me?’” Hernandez recalls with a laugh. “Cal State Fullerton was my first choice to pursue my geology degree, and I’m so glad I attended. My applied geology coursework prepared me well for my career in both consulting geology and as an engineering geologist for the state.”

Now a senior engineering geologist for the California Geological Survey (CGS), the 1995 Cal State Fullerton alumna was honored as the College of Natural Sciences & Mathematics Geological Sciences 2019 Alumni of the Year.

Serving as Geology Club president for two years while a student at Cal State Fullerton only amplified her enthusiasm and gave her confidence for future roles. Hernandez started

at CGS in 2001 after earning her professional geologist license. She was promoted to acting senior engineering geologist in 2017 and the permanent position in 2018.

Hernandez has been involved in a wide range of fascinating projects in her career. These have included mapping debris flow inundation after the Thomas Fire in Montecito; guided wave seismic studies on the Santa Monica, Raymond, and Hollywood faults; and performing detailed geologic mapping of the Peninsular Ranges batholith and the Elsinore Fault Zone. Her Elsinore work involved developing positive relationships with the Native American tribes living on that land, “to help everyone with future planning, seismic hazard awareness, and emergency response.”



TraNSMission

When it comes to earthquakes, most people who've lived through one feel like the worst is over after the first shock hits. That wasn't the case in July 2019, when a magnitude 6.4 earthquake struck California's Mojave Desert near Ridgecrest on the 4th, then a magnitude 7.1 earthquake rocked the area again on the 5th. Hernandez was the first CGS Geologist on-site after the July 4 earthquake. She and other scientists measured offset at one of the first reported locations, across Highway 178. The night of the July 5 quake, a team of geologists went back out to the highway at the marked location and saw no additional movement, but farther east along the highway, there was a separate set of much larger ruptures oriented perpendicular to the July 4 event.

"The Ridgecrest events included at least two dozen faults that splay off of the main fault, generally at a 30-degree angle," she says. "The complex faulting we observed will require us to make our Earthquake Fault Zones wider."

The Ridgecrest quakes show that small faults can join to produce a large, widespread earthquake. An earthquake affecting a smaller fault can destabilize larger ones, sparking a much stronger earthquake.

Coordinating field efforts after these complex quakes was a challenge, says Hernandez, but critical to capture important slip data from each rupture surface. These ruptures occurred in a relatively sparsely occupied location, or things would have been much worse in terms of lives lost and infrastructure damage, she adds. •

COLLEGE NEWS

Jeffrey Knott, emeritus professor of geology, was awarded a fellowship by the Geological Society of America for his research on Late Cenozoic paleoenvironmental change and landscape evolution, contributions to the understanding of Death Valley and the surrounding regions, and exceptional teaching and training of undergraduate and graduate students.

The Center for Applied Biotechnology Studies (CABS) hosted the 4th annual CABSCon4 Biotechnology Symposium on Nov. 8, 2019. Attendees explored and discussed the latest advances in different disciplines of biotechnology, and listened to speakers that included **Veronica Jimenez**, associate professor of biological science. Jimenez gave a presentation about the process by which a parasitic infection called Chagas disease targets specific cells, and how understanding this process can aid in the development of new therapies. In addition to Jimenez and presenters from other universities and biotechnology companies, several students presented their research and competed for prizes.



Julia Y.K. Chan, assistant professor of chemistry and biochemistry, and **Kathryn Metcalf**, assistant professor of geological science, recently joined the faculty of the College of Natural Sciences & Mathematics. Chan is focused on improving teaching in chemistry using a variety of different learning strategies both inside and outside the classroom, while Metcalf is focused on using geophysics to understand how mountains form.

With their research adviser, undergraduate chemistry majors **Jose Gonzalez Jimenez** and **Daniel Sandoval** recently conducted experiments studying the separation of oxygen from air at the U.S. Department of Energy's Oak Ridge National Laboratory. The researchers' work is helping to advance Assistant Professor of Chemistry and Biochemistry Allyson Fry-Petit's faculty-student research project on oxygen transport membranes. Only a few undergraduates are invited to work at the lab and use the special instrument called POWGEN, a neutron powder diffractometer.

Five students from Cal State Fullerton, including two NSM students, spent the summer of 2019 participating in the Minority Health and Health Disparities International Research Training Program, which recently received a new five-year grant from the National Institutes of Health that will help the program continue to grow. The students studied health issues in countries across the world:

Biological science-molecular biology and biotechnology major **Jonathan Azenon** worked in Argentina on research to develop a new test for a highly contagious bacterial infection called brucellosis.



Robert Soto, assistant professor of mathematics, was featured in Lathisms, an organization that provides a platform that showcases contributions of

Latinx and Hispanic mathematicians, during Hispanic Heritage Month (Sept. 15 – Oct. 15). The organization highlighted his background growing up as a child of undocumented immigrants, his academic success, his research in finite dimensional algebras and universal deformation rings, and his passion for mentoring students and providing early research experiences and hands-on learning opportunities. Lathisms also noted Soto's role as a faculty advisor for the PRIME (Pursuing Research in Mathematical Endeavors) Club, which is a CSUF student group that supports students from historically underrepresented backgrounds in mathematics to help them succeed in STEM careers.

Animation major **Vikki Brown** is making waves as the artist in residence for the Gravitational Wave Physics and Astronomy Center. Using data collected from gravitational wave detection instruments located across the world, which is then analyzed at the center, she helps create animations of celestial events. One simulation Brown created recently depicts a neutron star being sucked into a black hole. She has also worked on a 3D rendering of a proposed next-generation detector with L-shaped arms that stretch 40 kilometers in length.



Mason Emery, who is working toward his master's degree in biology, has put forward a strong proposal for a 2020 Sea Grant project to restore local eelgrass and oyster beds along the Southern California coastline. Emery's research is under the supervision of Danielle Zacherl, professor of biological science, and they are working in conjunction with the Honda Marine Science Foundation and other local groups interested in restoring California coastlines.

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