UCLA

We are Mathematics

Letter from the Chair

Welcome to one of the strongest departments at UCLA! Our main mission is excellence in research and education. This is demonstrated by a long history of academic achievement combined with a sustained commitment to diversity and equal representation among our faculty, students and staff. UCLA mathematics consistently places within the top 10 universities in preeminent national and international quality surveys. In 2018, the *U.S. News and World Report* ranked our graduate program seventh in the country, and the Academic Ranking of World Universities put us at number eight among all departments of mathematics across the globe!

"Our Department impacts almost every UCLA student. We are passionate about each one."

Specialty Rankings:

# 1	Analysis
# 2	Applied Mathematics
# 2	Logic
# 7	Topology
# 8	Algebra/ Number Theory/ Algebraic Geometry
#11	Discrete Mathematics and Combinatorics
#12	Geometry

2018 U.S. News & World Report Best Grad Schools

We take pride in maintaining such a high academic standing, which is reflected in the research excellence of our faculty. Many of our colleagues have had their work acknowledged with high academic honors. Stan Osher received the Gauss Prize in 2014 and Terry Tao the Fields Medal in 2006. Very recently, Andrea Bertozzi was elected to the National Academy of Sciences (NAS). This past summer, five of our colleagues (Matthias Aschenbrenner, Andrea Bertozzi, Ciprian Manolescu, Igor Pak, and Sucharit Sarkar) were invited to speak at the International Congress of Mathematicians (ICM) – one of the highest honors for academic research. We also reach outside of campus to bring eminent international mathematicians to UCLA with our own Distinguished Lecture Series. Each year we invite two to four lecturers to week-long events attended by both faculty and graduate students.

Our Department impacts almost every UCLA student. We are passionate about each one. A large percentage of UCLA undergraduates take our courses every year, and increasingly more choose to become math majors. Our reputation is measured by their success. We are proud of those who shine. This academic year, our UCLA team placed fifth in the 2017 William Lowell Putnam Mathematical Competition – the preeminent and notoriously difficult contest for undergraduates. Five UCLA students received honorable mentions for placing in the top 100 students in North America. One UCLA student received the Elizabeth Lowell Putnam Prize for the highest ranked woman.

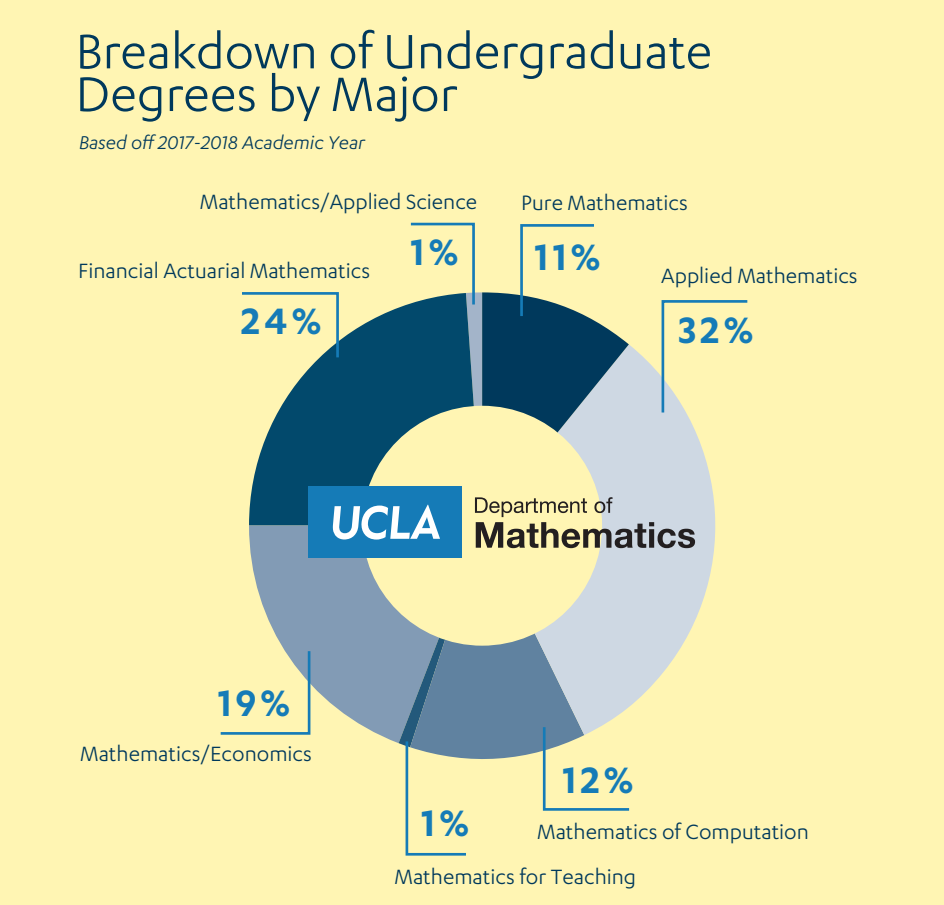
Our interdisciplinary REU (research experiences for undergraduates) program continues to provide cutting edge training in applied

mathematics each summer as part of the NSF-sponsored UCLA Computational and Applied Mathematics Research Experience. The Department has been a leading force in this program for over a decade. Recruited from across the country, undergraduate students receive training in model fitting, image analysis, scaling, data analysis and error estimation. They learn how to prepare their research for publication and present their findings to an audience. Our REU program is a key national initiative to build skills and interest in academic research careers across the sciences. We are honored to be part of it!

Many of our efforts in research and education are nurtured by our donors, the many individuals who commit to the Department each year, along with our matching corporate gifts. We extend to them our profound gratitude. This year, a donation from Professor Emeritus Masamichi Takesaki has endowed a new chair in the theory of operator algebras. This million-dollar gift will enable us to recruit and retain high-caliber researchers, strengthen the quality of teaching, and support research collaborations in this important area of pure mathematics.

We believe that public universities, such as UCLA, should reflect the communities they serve. Given the critical role that mathematics plays in technology, healthcare, industry, commerce and many other aspects of work and life, it is in the best interest of our society to promote and build mathematical competence across as many sections of our population as possible. We are committed to this effort. Outreach has always been important for us – we are here for our community!

Our Curtis Center focuses on developing and supporting quality mathematics programs that interface with the K-16 community. Our distinctive Los Angeles Math Circle provides enrichment activities for hundreds of young school children while giving our undergraduate and graduate students valuable teaching experiences. More recently, the Women in Math group was initiated by our graduate students to foster a welcoming place for women in the Department. We want to stay connected and cultivate the talent that grows from our efforts. This coming year we are planning several new initiatives that will serve this cause.



We are always happy to welcome our alumni back to the Department and hear their latest news. The work of two of them, Ariana Anderson and Lauren Dunlap, on a unique program called Chatterbaby has drawn international attention. Chatterbaby analyzes and interprets babies' cries to help parents and researchers to better understand what babies are trying to communicate. We anticipate that their efforts will strengthen current research focused on early diagnosis of developmental disorders.

Another distinguished alumna, Danica McKellar, was recognized with the university's 2018 Science and Education Pioneer Award for her work as an education advocate and mathematics writer. Three of her books were New York Times bestsellers. We fully support Danica's mission, to encourage middle-school and high-school girls to have confidence and succeed in mathematics.

Going forward, we want to maintain our legacy of excellence while seeking out new mathematical worlds. The quest for scientific discovery is a very human trait. By nature we are curious about the unknown, and we want to boldly go where no one has gone before. While we will continue to harness this human appetite for exploration by breaking new ground, pioneering new theories and making the world a better place, we know that it mostly comes down to people – nourishing them and watching them excel. We are mathematics, and we welcome you!

Mario Bonk
Professor and Chair
UCLA Department of Mathematics

UP CLOSE AND PERSONAL

Department faculty conduct and share high quality, often very specialized research in a wide range of activities and venues, but in some cases they particularly value research as an opportunity to bring people together from across disciplines.

The Culture of Mathematics

While many Department activities are organized within its diverse mathematics fields, the Distinguished Lecture Series is unique in its collaborative nature, appealing to faculty and students across the mathematics spectrum and beyond. The lecture is also unique in its structure – not a one-day seminar but an extended platform of a week or more.

Terry Tao, the current faculty administrator for the lecture series, suggests that "in order to do math research today, you have to know what's going on in other fields, including outside of math, especially in physics, economics and computer science. We call it the culture of mathematics."

Each year, two-to-four eminent international mathematicians are invited to lead individual Department residencies, meeting with faculty and graduate students in a range of lectures and events. An introductory lecture is geared to a general mathematics audience, while second and third lectures are more advanced, focusing on the speaker's specific area of expertise. The lecturer meets with graduate math students in an inclusive lunch, which encourages informal interaction and provides an opportunity for the students to get to know the lecturer on a more personal level. Students gain career advice and explore subject specific matters that may contribute to their theses. Lecturers also hold "office hours" during their residencies to confer with students, faculty and visitors on a one-to-one basis. Afternoon tea gatherings and a separate dinner open to both faculty and students offer other networking opportunities.

"I would say that the program humanizes math and mathematicians," says Terry. "You read about major figures who prove big theorems and achieve legendary status, and you come to think of them as academic lions. By inviting them to speak and meet with us in a more intimate setting, we get to know them as persons and peers. It reminds us that mathematics is a human activity, it's not just a job for superheroes."

The Distinguished Lecture Series is currently supported by the Wiener Fund. For more information, please visit https://www.math.ucla.edu/dls.

Hands-On Experience

With major support by the National Sciences Foundation, the UCLA Computational and Applied Mathematics Research Experiences for Undergraduates (REU) program offers undergrads an opportunity to conduct cutting edge applied mathematics research for eight weeks during the summer.

Recruited from across the country, including UCLA, undergraduate math students are assigned to specific project teams and paired with graduate advisors and faculty mentors for the full eight weeks. Participants receive training in model fitting, image analysis, scaling, data analysis and error estimation. And they also learn how to prepare their research for publication. At the end of the program, students present their findings to an audience, which helps them to develop their communication skills and clearly and concisely describe complex research topics.

The REU program is interdisciplinary – UCLA math faculty collaborate with their colleagues in medicine, anthropology, engineering, chemistry and other disciplines. Also included are postdocs and junior faculty who highly value these mentoring experiences. With the students, they build mathematical models for problems related to biology, social sciences and physics.

2018 computational and applied math REU group

Colleen Chan, a recent UCSD graduate, wasn't sure if a research career was a good fit for her. After being recommended to the program by her professor, she decided to try it out for the summer. Most importantly, she recalls, it gave her hands-on mathematical experience. "I hadn't done that before, and I loved it. I was sold, and I knew I wanted to do a PhD. I think it also opened a lot of doors for me because it was UCLA." One of the main takeaways from the program for Colleen was the people. Her project team of five, from UCLA and UCSD as well as Pomona, Harvey Mudd and Santa Monica colleges, approached their research from different perspectives, prepared by their respective schools and math interests. "We were very open with each other, which was fun and made me think that I could see myself doing this for a long time."

Colleen's team is working on publishing its findings, and the experience has led her to other research opportunities. She is currently working as a research assistant and statistical consultant for UCSD's Rady School of Management, and with the help of the GRE workshops that REU provides, she confidently applied to graduate schools this year. She was accepted into Yale where she will complete her PhD in statistics and data science. "I'm just very grateful. I've learned so much, and I've made lasting friendships. I highly recommend the program to any math undergrad who's considering a research career."

The REU modules cover a range of topics – crime modeling, fluid dynamics, robotics and control, medical imaging, cancer stem cells, bone growth, remote sensing applications, alcohol biosensors, photovoltaic cells, and algorithm design for microscopy. This year, UCLA math postdoc Omri Azencot led a summer project on crime modeling, which included UCLA undergraduates Aviva Prins, Yifan Li, and Qinyi Zeng and UC Berkeley student Jiazhong Mei. Aviva Prins is a third-year REU veteran.

Aviva affirms, "My experience working with UCLA faculty, especially the postdocs, has been really positive. They give me feedback on writing papers and tips on how to organize information, and their guidance is always on point." Aviva not only feels more confident in her research ability but enjoys knowing that her team's numerical analysis will ultimately contribute to an important research objective. "I care a lot about giving back to the community, and I'm glad that we can help make sense of the data that's generated by the project and make sure it's useful."

Crime modeling has been a core feature over the decade-long REU program, serving as a locus for both participants and contributors. The ever-evolving research is undertaken by the Department's applied mathematics scientist and REU director Andrea Bertozzi in partnership with other UCLA faculty and cooperatively with Los Angeles and similar cities around the world. Currently, the research group is working on a project with the Los Angeles Mayor's Office of Gang Reduction and Youth Development (GRYD) in Los Angeles. Established in 2007, the GRYD program is dedicated to fostering the development of city youth and reducing the influence of street gangs in their lives. Project leader Jeff Brantingham, a professor in the UCLA Department of Anthropology, is joined by Andrea Bertozzi and statistics professors Rick Schoenberg and Erin Hartman. Together, they are tasked with the data analytics for the GRYD program, including analysis of crime and questionnaire data. Their primary goal is to identify youths most at risk for joining gangs. This summer, the REU program lent a vital and enthusiastic helping hand to this analysis.

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Applications for UCLA's REU program are due in the spring of each year. Visit https://www.marcusroper.org/reuucla/

AT THE FOREFRONT

Once every four years, the International Congress of Mathematicians (ICM) hosts thousands of scholars from over a hundred countries. Acknowledged as one of the world's premier forums for new mathematical discoveries, the lectures appeal to both noted scholars and aspiring ones. Since 1962, Department faculty have been consistently honored; this year five UCLA mathematicians were invited to speak.

Saint Petersburg, Russia, will host the 2022 ICM.

Profs. Igor Pak, Ciprian Manolescu, Andrea Bertozzi, Sucharit Sarkar and Matthias Aschenbrenner

Five for the ICM

The 2018 ICM was held in Rio de Janeiro, Brazil, making it the first Latin American venue in the conference's 121-year history. UCLA math professors **Matthias Aschenbrenner**, **Andrea Bertozzi**, **Ciprian Manolescu**, **Igor Pak** and **Sucharit Sarkar** were invited to give talks in their respective areas. Department Chair Mario Bonk noted, "We are deeply honored. The presence of five UCLA mathematicians representing different disciplines is indicative of the high level of our faculty research."

Says Matthias, "For me, the highlight of the conference was the presentation of the Leelavati Prize to Turkish mathematician (and fellow model theorist!) Ali Nesin for founding the Nesin Mathematical Village," which is a unique and remarkable retreat in the mountains of his homeland. Matthias' research interests include differential algebra and model theory. He studies algebraic differential equations using methods from algebra and logic. In his talk, he presented the results of a 15-year project that he has been pursuing with Lou van den Dries (University of Illinois) and Joris van der Hoeven (École Polytechnique).

For Andrea, the highlight of the conference was a satellite meeting in Niterói, a municipality across the bridge from Rio. She says, "I was able to meet with some of the best mathematicians in Brazil who are researching problems related to my work." An applied mathematician with wide-ranging projects, Andrea's talk described data clustering methods that can be used to automatically classify information, such as gas plume detection in hyperspectral video and activity detection in body cameras.

Ciprian lectured on the applications of gauge theory to topology, specifically, understanding the homology cobordism group in dimension three, which controls the study of triangulations of manifolds. Gauge theory and low-dimensional topology are key research areas for him, in addition to symplectic geometry. He sketched his disproof of the triangulation conjecture, a result from previous work and discussed some unresolved conjectures. Says Ciprian, "It was gratifying to see one of these unresolved conjectures proved a few months later in a collaboration that included one of my former students."

Igor was struck by the international appeal of the conference. "I think a global perspective energizes young people, and it helps to popularize math education." He commends the venues, which encompass both developed and developing countries. The last five ICMs were held in Brazil, South Korea, India, Spain and China. Igor's current research focus is in combinatorial and complexity properties of integer sequences arising in enumerative combinatorics. Igor explains, "My talk summarizes the state of the art of the subject and opens new venues and directions. The complexity theoretic approach I presented is especially unusual and rarely discussed in this context."

Sucharit believes that a talk is a much better way to introduce a subject than a paper, especially when it's the ICM and your audience comprises topologists from all over the world. Sucharit gave a joint lecture with Robert Lipshitz (University of Oregon) who shares his interest in stable homotopy refinements. Their lecture focused on strategies to spatially refine chain complexes, which arise naturally in low-dimensional topology. Sucharit explains, "In dimensions up to 4, there are various examples of naturally occurring chain complexes that help us understand the structures of low-dimensional objects. We want to spatially refine these chain complexes, creating new spaces whose singular chain complexes are the original ones. This will help us understand the original low-dimensional objects in greater detail."

For all five UCLA mathematicians, this was their first ICM.

Honoring Andrea Bertozzi

An academic treasure since its inception by an Act of Congress in 1863, the National Academy of Sciences charges its distinguished members with sharing their independent and objective knowledge with the nation on matters related to science and technology. Each year, 100 American scholars are elected to the society based on their outstanding contributions to scientific research. Elections are conducted in secret.

When an unsuspecting Andrea was awakened at 6:15 A.M. on May 1, 2018, she thought it was just a stranger calling. After a short round of challenges on either end of the call, Andrea finally identified herself and was congratulated by a representative from the National Academy of Sciences (NAS) on her election to this exclusive group. It is one of the highest honors afforded to scientists in the United States – nearly 500 members have won the Nobel Prize, and the *Proceedings of the National Academy of Sciences* is one of the premier international journals publishing the results of original research.

Membership in NAS is the latest of many honors and awards that Andrea has accrued during her professional life. She takes them in stride, using the accolades to further her two passions – multifaceted research and student advancement.

In terms of research, Andrea has received extensive press coverage for her ongoing analysis of crime statistics, working with UCLA Professor of Anthropology Jeffrey Brantingham and law enforcement agencies, particularly the Los Angeles Police Department. However, the scope of her research is much broader. She has worked in a number of far ranging areas from nano and microscale physics to cooperative robotic control to fundamental questions about fluid flow, and more recently data science. Andrea says, "What's beautiful about mathematics is that it's a language that can be used for so many different, diverse applications." She asserts that much of her research strength lies in her commitment to interdisciplinary collaboration and understanding where math can have a voice.

In terms of teaching, Andrea's concerted efforts to bring students into academic research and publication is most prominently demonstrated by her leadership in the UCLA Computational and Applied Mathematics Research Experiences for Undergraduates (REU) program, which offers opportunities for 40-50 promising undergrads to participate in cutting edge applied mathematics projects each summer. She has been running this program, in collaboration with faculty from UCLA and other local colleges, for over 10 years, instilling in hundreds of undergrads a passion for academic research across multiple disciplines. Her success and her popularity are due to her inclusive instructional practices. She says, "We are not just doing projects geared to undergrads, or grads, or postdocs. I want the students at different levels to work together on our projects and to learn how to write publishable papers." Her record in supervising graduate students and post-docs is impressive. To date, she has trained 37 PhDs and mentored over 40 post-docs.

Asked how she manages her herculean workload, Andrea explains she has a really supportive husband. "I don't think I would be here without him. He's put his career second to mine, and to get to the point where I am, I needed somebody to cheer me on and pick up the pieces when necessary."

She points out that she's not the first person in her family to be elected to the NAS. "I have a sister who is younger than me who got in many years ago, and I'm really proud of her. I knew she was going to do something big." While she and her sister have enjoyed a typical American middle-class lifestyle, it wasn't that way for her grandparents who were Italian immigrants on her father's side. Her father and his four siblings all went to college, the first in their family. "My father was the youngest, and he got his PhD in physics with the help of his brothers and sisters. Her mother received her bachelor's degree from Wellesley as a Davis Scholar when she was in her 60s. "In my house it wasn't whether I was going to college, but where."

Growing up, Andrea was fortunate to have motivating parents. Her father taught her math beginning at a young age, but by the time she was a teenager, she didn't need his help anymore. "In school, I didn't push myself to the point where I was super accelerated in math because I wanted to enjoy the other parts of school, like music. In summers during high school, I was a life guard. So I was a little ahead, but not many grades ahead. I wanted more balance. I'm glad I did it that way because in applied math, you need to know more than just math. You have to understand other aspects of life beyond solving equations. I credit a lot of my success to the experiences I had as a young person. My first teaching experience was training five-year-olds how to swim."

"We are not just doing projects geared to undergrads, or grads, or postdocs. I want the students at different levels to work together on our projects and to learn how to write publishable papers."

When asked how she thinks her NAS membership will enhance her career, Andrea doesn't hesitate. "I hope it will help me establish new connections with new people. I think that's what an ideal academic life is all about."

DEDICATED TO EXCELLENCE

The Department's commitment to outstanding academic achievement within an inclusive community provides a durable foundation for future success in mathematics and beyond for all students. In a collaborate environment, students and faculty lend a helping hand to lift each other up.

UCLA Math Team Ranks 5th in Putnam Competition with Top Ranked Putnam Female

Ni Yan became interested in math competitions in China during elementary school because she thought they were trickier and more practical than school math. Upon coming to UCLA as an undergrad student, it was only natural that she join the UCLA Putnam team. She says, "For me, it was a chance to combine the logic and thinking that I've gained from all my math competitions over the years with the new theories I was learning in college."

In the 2017 Putnam competition, Ni received the Elizabeth Lowell Putnam Award for the highest ranked female in the country. She was also one of five UCLA students who received an Honorable Mention. She was surprised. "I didn't expect the prize. My friends and family were all very proud of me."

Led by faculty advisor Ciprian Manolescu, the three UCLA Putnam team members (Xiaoyu Huang, Konstantin Miagkov and Ni Yan) spent an intense fall quarter helping each other prepare. Ciprian, who is becoming something of a Putnam legend, leads an advanced problem-solving seminar for those students who score highest on a practice test. They spend three hours each week using critical thinking to solve a wide range of problems, which are analogous to ones in the Putnam test. Says Ni, "He helped clear our minds, both the presenters and the listeners, and when nobody had a clue, he brought us to the answer step by step."

The UCLA math team ranked 5th out of 575 institutions in the 2017 Putnam competition. Of the 35 UCLA students competing, five received Honorable Mentions: Emre Girgin, Xiaoyu Huang, Konstantin Miagkov, Alexandru Pascadi and Ni Yan. All ranked in the top 100 students.

Over her many years of competing, Ni has noticed the gender discrepancy. "Males have always dominated math competitions. I'm the highest ranked female in this test, but there are more than thirty students better than me, all male. I don't think girls are bad at math. I believe we are just as capable." Ni recommends that undergrads interested in math competitions take classes in linear algebra and analysis that deal with proofs and help build logical thinking.

Ni was drawn to UCLA because of its highly ranked applied math program. She was also looking forward to learning a new culture and seeing how people in a different world than hers think and learn. She graduated from UCLA in applied math and statistics in 2018 with a specialization in computation. With her Putnam experience and UCLA degree in hand, Ni felt confident about pursuing a PhD. She wants to apply mathematics to related fields, such as economics, statistics or medicine.

For more information about math undergraduate majors and the Putnam competition, please visit www.math.ucla.edu/ugrad/putnam-competition.

The William Lowell Putnam Mathematical Competition for university undergraduates is an annual exam that showcases the best math students in North America.

Math undergrad Ni Yan, recipient of the Elizabeth Lowell Putnam Award for the highest ranked female

Math undergrads meet their grad mentors as part of the Women in Math Mentorship Program

UCLA Women in Math Mentorship Program Launched

Established in 2010, UCLA Women in Math (WIM) is an informal group of graduate students and postdocs who actively support and nurture UCLA women in mathematics. This past year, the group undertook the complex task of actively mentoring women undergrads. With substantially fewer women than men in the student bodies of both the Department and across academia, navigating a math major, let alone a career in math, creates challenges that can discourage interest in the field.

The newly organized UCLA Women in Math Mentorship Program addresses the gender gap by enlisting women grad students to become mentors for their undergrad counterparts. To publicize the program and assist with recruitment, quarterly dinners are organized for both grad and undergrad students. There they can make connections, share experiences and offer tips for success. Program coordinator Denali Molitor is surprised by the number of respondents. In just its first year, over 30 graduate and undergraduate students have joined the program, and the numbers are expected to grow.

Denali, explains, "The men in the Department are great, but I've been very aware of often being the only woman in the room. It can be intimidating walking in by yourself, especially as an undergrad. Sometimes just knowing a woman who is already a mathematician makes a huge difference." Whether it's pausing to chat in the hallway or grabbing coffee, every small interaction helps to make women undergrads feel less isolated and part of a small but familiar community within the larger community of the Department.

In addition to support and friendship, the mentoring program sees an important role in helping women undergrads imagine themselves in a range of professional roles that are informed by the field of mathematics in general, and by a math degree in particular. The best way to do this is to help women get involved with the many activities afforded to all students in the Department, such as research, study groups, clubs and competitions. These are true and tested paths to increased visibility in an academic community and fuller interaction with grads, postdocs and faculty. In the coming year, talks will be organized to give women undergrads more insight into professional opportunities in mathematics.

Learn more about UCLA Women in Math Mentorship Program at https://www.math.ucla.edu/grad/women-in-math-mentorship-program.

Women in Math (WIM) is currently funded by the UCLA Department of Mathematics.

ALUMNI PAY IT FORWARD

Chatterbabies

In the 1950s long before brain imaging was available, physicians found that infants with brain damage had differences in their cry patterns. Researchers conjectured that just as slurred speech in adults is an indicator of a stroke, different cry patterns in babies may indicate neurological problems. This has to do with the nerves at the base of the brain that are related to speech. If a baby has issues in that area of the brain, speech – simulated by crying – serves as a warning sign. Seventy years later, researchers still believe that a baby's cry may be a crucial predictor of developmental delays.

Chatterbaby app developer Lauren Dunlap '17

When Lauren Dunlap transferred to UCLA from community college in 2015, she wanted to explore opportunities in the biomedical field that would build on her math curriculum and software engineering skills. With these goals in mind, she decided to compete in the Code for the Mission App Competition, sponsored by the UCLA Office of Technology. She built a mobile app for a unique research project called "Chatterbaby," which analyzes and interprets babies' cries.

She recalls, "As an added incentive, there was the potential to impact the lives of new parents – what do their babies' cries mean?" She worked tirelessly over the summer of her junior year and won first prize in the "Code's" 2016 competition. Lauren says, "What I didn't expect is that the project would extend beyond the competition. We just had so much fun working together it seemed natural to continue."

Chatterbaby was developed by Ariana Anderson, an assistant professor at the UCLA Semel Institute for Neuroscience and Human Behavior and a mother of four. Ariana is a committed alumna, receiving her bachelor's degree in mathematics, her doctorate in statistics, and her postdoctoral fellowship in psychiatry, all at UCLA. But she considers math to be the basis of her career. She came up with the idea of Chatterbaby when she noticed similar features across all of her own babies' cries, for instance, one type of cry for attention, one for hunger, one for duress. She explains, "Having a pure math background has helped me with abstract thinking, which led me to Chatterbaby."

Once the project was conceptualized, she and her team created a rigorous analytical framework for the research using machine learning algorithms to look for acoustic features in babies' cries that would identify distinct needs. "Then we were able to train AI models to predict why a baby is crying," Ariana explains. "For instance, we can predict acute infant pain now with over 90 percent accuracy." Pain cries are recorded when babies get vaccinations and ear piercings.

Chatterbaby is a team effort, largely reliant on an army of volunteers – there were 14 coauthors on the first paper. Undergrads assisted with initial data collection, and four neonatologists and two early child development experts participated in interpreting the cries. Others provided scientific input, organized data, and trained AI models. Ariana proudly maintains that the project has been a showcase of the wide range of talent at UCLA.

Support the cause

Chatterbaby is currently funded by the UCLA Clinical and Translational Science Institute, the Semel Institute for Neuroscience and Human Behavior at UCLA, the Burroughs Wellcome Fund, and private donations. For opportunities to support or participate in this study, check out the website: chatterbaby.org.

On a practical level, employing the study on a mobile platform enables the team to more easily recruit parents for the health surveys, which are a central part of the research effort. Says Lauren, "A major feature of the app is that it's not geographically bound, so it can go wherever the baby goes, like the doctor's office and the mall." This has extended the capability and reach of the data collection.

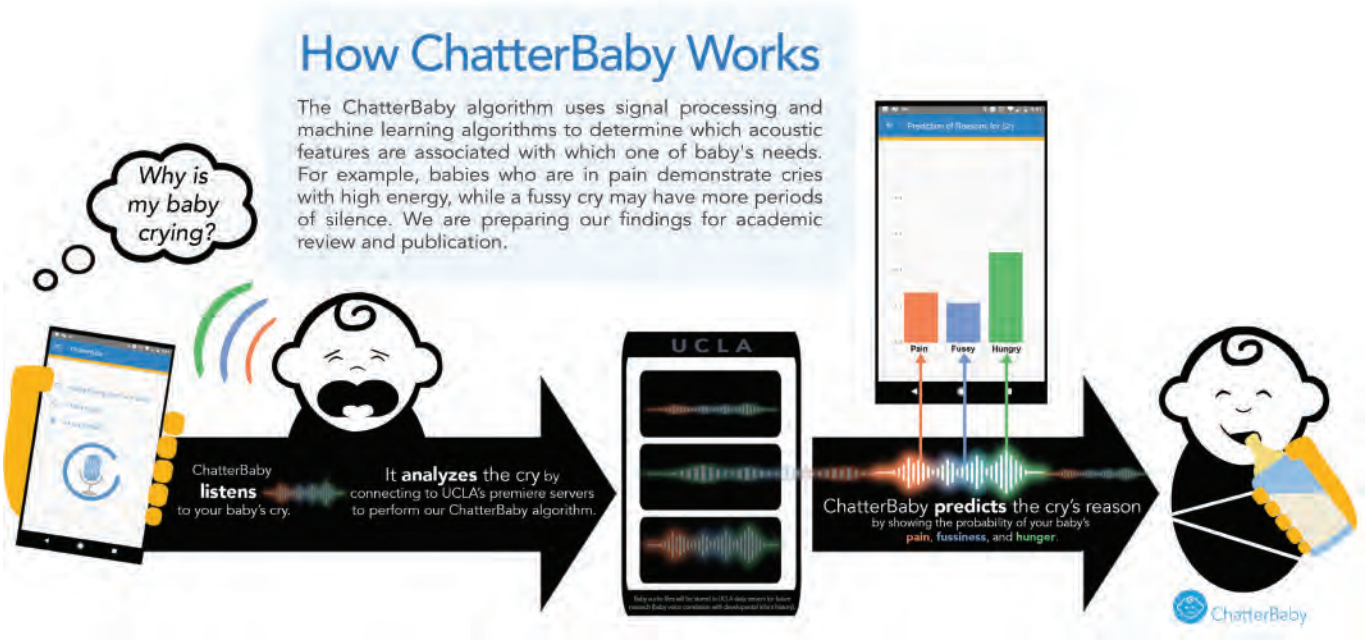
When parents sign up for the app, they agree to the recording and collection of their babies' cries. They are also asked to complete voluntary surveys, which give Ariana's team extensive information about the babies' health and background. In return, the team provides feedback to these parents on their babies' risk factors for autism and other conditions.

"For example," Ariana explains, "from the surveys we know whether mom had a complicated pregnancy, used drugs, or had a family history of schizophrenia or other mental or physical health issues in the family. We also ask behavioral and developmental questions, such as whether babies make eye contact or feed properly – all sorts of things that might indicate if the baby has an increased risk for developing some sort of disorder. Sometimes it's easier for parents to divulge this kind of information in an anonymous survey rather than directly to a doctor."

After winning the app competition, Lauren was offered a laboratory job in the David Geffen School of Medicine. In her demanding senior year, she added a job, and she continued working on the Chatterbaby app. She says, "This is when it became really difficult because it was about time management and balancing the workload." She did it all, graduating in 2017 with a degree in applied math with a specialization in computation.

RESEARCH TRAJECTORY

Founded in 2013, Chatterbaby's first project was to help deaf parents respond to their babies' cries without the benefit of vocal cues. The team had gathered 2,000 babies' cries at that point. With the introduction of the app and increased visibility of the research, the database has grown to 500,000 cries from all over the world.



The current research is focused on early diagnosis of autism spectrum disorder. New data capability is helping the team to understand how babies' cries might determine their likelihood for developing autism, as symptoms generally appear in the first two years of life. Ariana reports, "There are some interesting studies on very small samples that suggest that babies who are at risk for autism cry differently. We don't yet know if these patterns will hold up scientifically in larger populations." In addition to verifying specific cry patterns common in babies, the team is able to look for other behavioral markers through the parent surveys. Babies in this study will be followed until they're six years old. In time the team is hoping to know if an abnormally crying baby at two weeks has a high probability of receiving an autism diagnosis by kindergarten.

THE FUTURE

"Since releasing the app, we've had incredible demand for it," notes Ariana, "because everyone wants a cry detection device. While it's a useful to tool for parents, as researchers we have secondary benefits. Our AI algorithms are now in their second generation, using deep learning to predict why a baby is crying. One of the things we'd like to do is bring the app into the neonatal intensive care unit to help us identify cries that indicate pain or other critical states. We're also on our way to perhaps creating one of the largest academic databases [for babies' cries], which we can share with the world. We're just starting to collaborate with people in other countries." Although the app is currently available only in English, other languages are being integrated. In the meantime, many of the information pages on Chatterbaby.org are available in Spanish, Chinese, French, Japanese and Hindi.

Currently, Chatterbaby researchers are in discussions with researchers in the country of Colombia who want to see how the cries of babies born prematurely differ from the cries of full-term babies. While UCLA researchers may contribute important information to such projects, they do not share actual babies' cries or parent surveys. The Colombian researchers will know the pitch, frequency and intensity of a cry from a specific 33-day-old baby, and they will know if it's a premature or full-term baby, but they will not be able to map this data back to the person.

As a result of the app, the sample size for Chatterbaby, once quite limited, is now a data goldmine, and as a result, the algorithms can be refined because unique data sets can be identified. Says Ariana, "We have many different directions we want to take the project. Right now we're looking for funding partners so we can extend our research – and also so we can bribe Lauren to never ever leave us."

The app is available for free download on Android and iOS. To lean more, visit Chatterbaby.org.

Use the app and ...

- donate data by sending an audio file of your baby crying and why you think s/he's crying.
- take a survey and receive a score that predicts the likelihood of your baby's risk for autism and other health conditions.

This information will help to build the Chatterbaby research database.

Math and Cool Meet

Actress, best-selling author and math alumna Danica McKellar was awarded the 2018 UCLA Science and Education Pioneer Award at the Exploring Your Universe science festival on campus this fall. Danica is an advocate for both education and mathematics, which she has demonstrated with her three *New York Times* bestselling books: *Math Doesn't Suck*, *Kiss My Math* and *Hot X: Algebra Exposed*. She employs her two passions – entertainment and mathematics – to empower young people, especially girls, and promote the notion that mathematicians can be glamourous and cool too.

THE IMPACT OF GIVING

A $1 million gift from Professor Emeritus Masamichi Takesaki will endow a new faculty chair, only the third such chair in the history of the Department. The Yuki, Kyoko, and Masamichi Takesaki Chair in Operator Algebras offers a pathway for recruitment and retention of top mathematicians, strengthening teaching and advancing research in the field.

Masamichi celebrating his 85th birthday with an operator algebras-themed cake

It Was a Natural Thing to Do

BY MASAMICHI TAKESAKI UCLA PROFESSOR EMERITUS OF MATHEMATICS

I grew up in Japan during World War II and the post-war period as we stumbled from militaristic imperialism to defeat to democracy. My father, a surgeon, was drafted into the military when I was in my first year of elementary school and returned when I was a second-year engineering student at university. As a result, I grew up in a home without a father's care. To overcome the void of his absence, my mother told me stories about our ancestor who was a war hero and fought against the Mongolian invasion in the 13th century. It helped to keep my ego strong and my self-esteem high.

For me, mathematics was a both a steadying force and a way to self-discovery, although at first I disliked it because I was bored. My attitude changed in high school when a mathematics teacher, who was preparing for his PhD, taught us Euclidean geometry. He was interesting; his material was different. In engineering school, another mathematician taught a beautiful calculus course based on the epsiron-delta argument. It opened my eyes. Motivated now, I started to study math on my own. For me, mathematical truth was beautiful and a barrier against the chaos of Japan at that time. I was eager to reconstruct my own mathematical world and ignore life. This commitment helped me to change course. I left engineering school to study math at Tohoku University.

Toward the end of my undergraduate years there, I discovered the double commutation theorem of J. von Neumann and fell in love with operator algebras. It seemed to bring together my entire mathematical background. I have since devoted myself to the subject, though by the time I found this passion, in the mid-fifties, operator algebras had become unfashionable. Regardless, remarkable deep results were obtained during this period, such as the celebrated paper of Sakai on the characterization of W*algebras, Kadison's transitivity theorem, and Glimm's breathtaking result on type I C*-algebras. I was convinced that the field was not dead; it just required more patience.

After I earned my MA in 1958, I obtained a research assistant position at the Tokyo Institute of Technology and withdrew from my PhD course. In Tokyo, the field of operator algebras was as unpopular as at Tohoku University, forcing me to once again create my own mathematical world. I firmly believed that the field was undergoing deep preparation for the next big jump, which came in the mid-sixties. In 1963, I was called back to Tohoku University to become an associate professor without a PhD, and two years later, several of us were granted our PhDs as a result of our publications. I came to the UCLA Department of Mathematics as a visiting associate professor in 1969 and stayed, accepting a tenured professorship in 1970.

I met my future wife, Kyoko, in my senior year of undergraduate study when I received teacher training in a girl's high school. The girl trainees organized a trek one day and viewing me as a harmless young man, recruited me to join them. It was the beginning of our long path together – 59 years. Our daughter, Yuki, was born in 1964, and throughout her childhood, Kyoko and I brought her with us on short and long trips all over the world. As a result, she quickly became an expert in languages, opting for a linguistics major at UC Berkeley. She also developed an interest in computers and was hired by Apple where she remained until her death at age 35.

Our biological lifeline will end now, but this donation – Kyoko's decision based on her strong commitment to public education – will carry our spiritual life into the future through an endowed chair. I believe that the field of operator algebras will flourish, and it will continue to influence and be influenced by general mathematics. Kyoko and I are grateful to UCLA for this wonderful opportunity.

Masamichi is an expert in functional analysis and operator algebras, obtaining several fundamental results in the subject, which now bear his name. His distinguished career includes a 1973 Guggenheim Fellowship and election to the inaugural class of American Mathematical Society Fellows in 2013. In 1990, he was awarded a Fujiwara Prize in Japan for his earlier work on the structure of von Neumann algebras of type III. At that time, the prize conferred 10 million Japanese yen (approximately equivalent to U.S. $90K) to the winner.

Kyoko and Masamichi Takesaki

UCLA Chancellor Gene Block, the Takesakis with a gift, and Dean of Physical Sciences Miguel A. Garcia-Garibay

UCLA faculty and close colleagues with the Takesakis in honor of the Yuki, Kyoko, and Masamichi Takesaki Endowed Chair

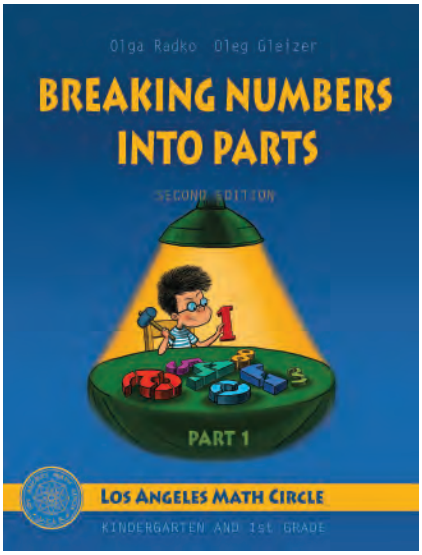
SHARING RESOURCES

Los Angeles Math Circle Expands to Satellites

For children who have an avid interest and talent in mathematics, the Los Angeles Math Circle (LAMC) is a unique and cherished enrichment program. Currently in its 11th year, the program attracts over 300 K-12 students annually.

During her own middle and high school years, LAMC founder and director Olga Radko attended a math circle, sponsored by the Moscow State University, in her native Russia. After becoming a faculty member at UCLA, she was inspired to start her own program. Olga stresses, "We are not teaching school curriculum; our program goes wider and deeper. We want our students to have fun and discover exciting and challenging ways to experience and learn mathematics."

LAMC's educational approach is different from teaching and learning in school. By using several instructors who circulate in the classroom and help the children individually, the program creates an engaging environment for learning new math concepts. Olga states that students need to "live through the [math] problem," which deepens their understanding. LAMC instructors introduce the topic and then guide the students in problem-solving.



Now in its second edition, this book helps young children gain fundamental knowledge in a fun way

This individualized approach enables LAMC to accommodate students of different ages and learning styles. In an afternoon, a student may complete one question while another may finish twenty. The objective is to leave the classroom understanding how to solve a mathematical problem, as opposed to solving as many problems as possible. "Many math classes focus on rote memorization and repetition, but we want kids to really understand the beauty of how math works."

The LAMC curriculum is employed by a team of nearly 40 UCLA undergraduate and graduate students, supervised by Olga. The program works hard to make unconventional topics available in a ready-to-use, packaged format. All the materials are then posted on the LAMC website. They are free of charge and openly available. Says Olga, "I just think it's about making education really accessible." Based on her work with those LAMC participants who are kindergarteners, Olga co-wrote a book, *Breaking Numbers into Parts*, with Oleg Gleizer. The book is now in its second edition.

DEVELOPING THE SATELLITE MATH CIRCLES

By 2015, Olga saw the need for expansion beyond the UCLA campus, so she developed an informal satellite platform, which current or former LAMC students can use to build their own programs, utilizing math circle curriculum and materials. The process to become an LAMC satellite is straightforward, although the job is not. To begin, prospective organizers contact Olga who helps them set up the satellites. Together they identify prospective students and develop key objectives. The goals are to bring disadvantaged students up to grade level and to work with advanced students who seek extra challenges and want to take part in math competitions.

Student-instructors in LAMC satellites vary in age. For instance, middle schoolers might teach elementary students, and high schoolers might teach middle schoolers. "Not only are the children benefiting, but the student-instructors are learning essential job and life skills," says Olga. "They grow in terms of speaking in public, setting realistic goals, managing projects and leading – being in charge as opposed to sitting and learning." Since many satellite instructors are still students themselves, Olga helps them choose the resources that best fit their specific needs and serves as a mentor and advisor.

SATELLITE MATH CIRCLES IN ACTION

LAMC satellites can be found at Red Oak Elementary School, Baldwin Stocker Elementary School, Sequoia Middle School, Madrona Middle school and Agoura High School.

LAMC Sample Topics

Elementary Schoolers: binary numbers; Roman Mayan numerals; Möbius strip; 3d shapes and their projections; logical puzzles

Middle Schoolers: introduction to proof methods (contradiction, induction, pigeonhole); geometry; mathematical games;

High Schoolers: all areas of pure math (combinatorics, number theory, geometry, topology) and modern applications (economics, movie animation, medical imaging)

Sahana leading a math lesson at Red Oak Elementary School

After Ji Won Kim discovered and explored math at LAMC, he joined the Madrona Math Club as an 8th grader. There he was inspired to recruit a math teacher to help lead the club, and he became a student-instructor himself. The club subsequently recruited a UCLA electrical engineer, enabling it to grow in scope and capability. Now participants prepare for local and national mathematics competitions, including MATHCOUNTS and AMC 8.

The Agoura Math Circle is the brain child of Pranav Kalyan, a current sophomore at Agoura High School and an LAMC participant. Now a student-run nonprofit organization, it started as an informal club in the family's garage. Initially, volunteer instructors created their own problems and followed a lecture-style format. Becoming a satellite program was a turning point. Using curriculum developed at LAMC, the group reorganized into a discussion-based format where students collaborate in solving problems guided by experienced instructors. The results of the new teaching style were recently reflected in AMC 8 and Math Kangaroo national competitions, where over 20 Agoura students received honor roll and national awards. Currently the Agoura Math Circle has about 375 participants, grades 1-9 attending in person and 300 students enrolled in an online program. This year, Agoura Math Circle launched a YouTube channel to engage online students.

Sahana Sri began attending LAMC at a very young age. While in elementary school, she launched an LAMC satellite math club at Red Oak Elementary School and led it successfully for two years. Now a middle schooler, she has started a new math club for both elementary and middle school students that prepares them for math competitions in an engaging way – they recently won third place at the Girls' Adventure in Math (GAIM) competition. Through LAMC's satellite program, Sahana has become a young leader who is an impact in her community.

LAMC is supported by the Department, the National Science Foundation and private donors. To learn more about the program and access materials, visit: http://www.math.ucla.edu/~radko/circles/.

Ellen Kulinsky enrolled in LAMC as an elementary school student in 2008. As she came to learn, LAMC often plays a decisive role in directing children's passion for math into a passion for math education. She became a student-instructor and was eventually given an opportunity to lead her own group. She loved every minute and every aspect of teaching math, a dedication that earned her an invitation to attend UC Berkeley's undergraduate math program as a distinguished Regents' and Chancellor's Scholar. There she assumed the position of a lead instructor in the Berkeley Math Circle and in the newly established "Math Taught the Right Way" program. She also launched her own "Bay Farm Mathletes" after-school program. Ellen's undergraduate career has afforded her many new teaching opportunities. She was a guest lecturer at the Stanford Math Circle, helped grade the Bay Area Math Olympiad, and served as assistant teacher in an undergraduate computer science course. She is currently the president of UC Berkeley Women in Mathematics. Ellen is graduating this academic year with a degree in applied math and a concentration in data analysis.

UCLA Department of Mathematics

405 Hilgard Avenue
Box 951555, Math Sciences, Suite 6363
Los Angeles, CA 90095-1555

@UCLAMATH

Linkedin.com/company/uclamathematics

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Professor and Chair
Mario Bonk

Chief Administrative Officer
Ronke Epps

Managing Editor
Christina-Marie Santillan

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Contributing Writers
Lisa Garibay
Barbara B. Pawley
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