QUEEN'S MATHEMATICAL
COMMUNICATOR
FALL 2022

An aperiodical issued by the
Department of Mathematics and Statistics
Queen's University, Kingston, Ontario, Canada K7L 3N6

WELCOME FROM THE HEAD, TROY DAY

I have just completed my first year as Head of Department and so this is my inaugural welcome letter. It has been an interesting and busy process over the past year as I got myself up to speed on the important issues facing the Department. It is also wonderful to see students back on campus in full force as things return to a new type of normal after more than two stressful and challenging years of COVID.

There have been a few big changes to our faculty and staff compliment during the past year. On the faculty side we are very happy to welcome Dr. **Maria Teresa Chiri** as an Assistant Professor in Applied Mathematics (see the story in the following pages). Maria Teresa underwent an unusual hiring process that was entirely virtual, and she accepted her position before she was able to even set foot on campus. We are thrilled she is now here!

On the staff side, after 36 years of tireless dedication to the Department as the Program Assistant for Mathematics and Engineering, **Johana Ng** has retired. We wish her the best and hope she manages to get some well-deserved time to relax. In her place we are very happy to welcome **Jen Powell**, who started last spring and has done a remarkable job of quickly getting on top of everything. We also bid farewell to our Departmental and Financial Assistant **Rianna Lewis** as she took up a new position in Medicine. In her place we are very happy to welcome **Israte Afroze**. We also welcomed **Sean Dougherty** as a Program Associate for the Mathematics and Engineering program.

The past year has also seen a number of promotions within the Department. **Wenyu Jiang** was promoted to Full Professor, and **Thomas Barthelmé** and **Brad Rodgers** were promoted to Associate Professor with Tenure. **Giusy Mazzone** also had her position as Assistant Professor renewed. Congratulations to all.

As you will see in the following pages, many of our students have also had great successes during the past year despite the challenges of COVID. These include both undergraduate and graduate students earning a variety of scholarships, prizes, and awards.

Finally, as we emerge from a long period of uncertainty and isolation, we are beginning to once again engage in a variety of outreach activities. Our Departmental Student Council (DSC), whose activities were severely constrained during covid times (see their ingenious Pi-day celebration) are now back in full social and cultural swing. We were very happy to have the return of our well-known Math Quest and RabbitMath programs. Dr. Felicia Magpantay also organized a well-received workshop and conference on Mathematical Epidemiology in August that attracted faculty, postdocs, graduate students and people from the public health sector from across North America (https://mast.queensu.ca/~math-ecology/). Lastly, this fall, during the week of September 19-25, 2022, we celebrated NSERC's Math Literacy Week. This included activities held in partnership with Kingston Libraries, as well as a Public Lecture by Professor David Earn from the Department of Mathematics and Statistics at McMaster University entitled "Learning from the pandemics of the last seven centuries." It is shaping up to be a busy and engaging new year!

DEPARTMENT NEWS

ERNST KANI: HOW MATHEMATICIANS CAN “MUCK THINGS UP”!

Some interesting news has recently appeared that relates to a 25-year-old theorem of Ernst Kani.

Suppose you want to send a message that can be read only by a designated receiver. That is, if intercepted by someone else, it cannot be read. Classic cryptography describes different ways to encode the message with a “key” that only the intended receiver will know.

But suppose you want to allow any unknown user to be able to send you a message that you can decipher but no one else can. What you need in that case is what’s called a public key, an algorithm that anyone can use to send a message that cannot be decoded by anyone except the owner of the key.

This idea became “hot” in the mid-70’s when different kinds of mathematics was used to construct “one-way” functions that were easy to compute but hard to invert.

One popular system was the RSA algorithm which was based on the fact that it was easy to multiply two large primes together to get a product *n* but was hard to factor *n*. At that time, we were all saying, hey isn’t this neat that number theory, one of the purest branches of mathematics, could have such a cool application. In fact, the key result behind the RSA algorithm is Fermat’s (Little) Theorem which is over 380 years old.

But with the rise in quantum computing, these simple approaches were no longer safe and new methods were needed, and the technology is now in rapid development.

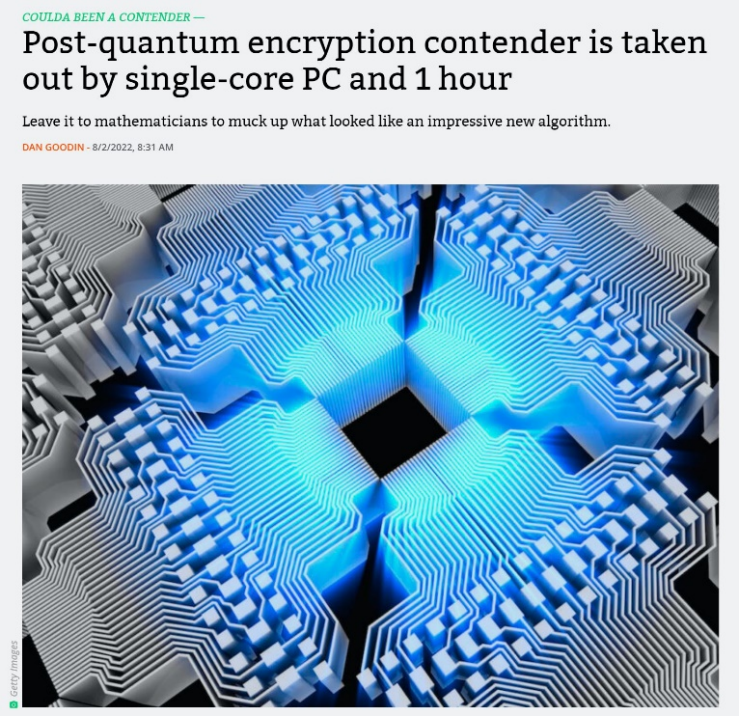
One of four leading contenders for a cryptographic security system that was meant to be secure, even against attacks involving quantum computing, was broken in one hour by a conventional single-core computer. The security system is known as SIKE—short for Supersingular Isogeny Key Encapsulation.

The cornerstone of SIKE is a protocol called SIDH. The research paper, just published, shows how SIDH is vulnerable to a theorem known as “glue-and-split” developed by Ernst Kani in 1997, as well as tools devised by fellow mathematicians Everett W. Howe, Franck Leprévost, and Bjorn Poonen in 2000.

Comments from Ernst.

“The story of my theorem goes back to joint work in 1991 with Gerhard Frey. We devised a general method of gluing two elliptic curves together to obtain a curve of genus 2. But sometimes this method fails (the curve "splits"), and my theorem classified precisely when this anomaly happens.

“The real champions here are W. Castryck and T. Decru, who used my criterion to break the system. It is far from obvious how to do this, and this is a very ingenious idea on their part.”



COULDA BEEN A CONTENDER —

Post-quantum encryption contender is taken out by single-core PC and 1 hour

Leave it to mathematicians to muck up what looked like an impressive new algorithm.

DAN GOODIN - 8/2/2022, 8:31 AM

WE WELCOME A NEW MEMBER OF FACULTY
MARIA TERESA CHIRI

“I graduated from University of Salento (B.Sc.) and University of Pisa (M.Sc.) in Mathematics, then I received my Ph.D. in Mathematical Analysis from University of Padua. Before joining Queen's as Assistant Professor, I did two years as a postdoc at Penn State.

“My research interest started from Dynamical Systems, going through Calculus of Variations until I landed to Optimal Control and Conservation Laws. A tangled journey perhaps—but was it indecision?

“Not at all. I just tried to take the best from the mathematical schools in which I trained. And what is at the end of this path? The main purpose of my research is to develop new analytical tools that can be useful toward the solution of real-life problems. I feel particularly motivated by those problems that have concrete applications, and which make me feel useful for society.

“In particular, I work on problems motivated by the control of invasive biological species, the confinement of forest fires, the improvement of traffic flow through autonomous vehicles, bioinspired PDE models (bio-robotics) and real-life situations modeled by using nonlinear hyperbolic systems of balance laws on networks.

“The best math tips (or challenges) that I have received, and which guide me in my daily work are:

1- The researcher and the human being are inseparable. How can you turn your character flaws into a mathematical strength?
2- Look for a place and people who will help you push out the math you have deep inside.

“Outside math I like reading, cooking, cinema and fashion (not nerd enough? well, let's break down the stereotypes about mathematicians). And if you don't find me in the office, I will certainly be walking by the lake with headphones on.”

WENYU JIANG
PROMOTED TO FULL PROFESSOR

"I graduated from the University of Waterloo, did a post-doctoral fellowship at the National U.S. Cancer Institute and then joined the faculty at Concordia University as an Assistant Professor. I came to Queen's in 2008.

“In my research, I develop new computational and theoretical methods in biostatistics. I have been working with colleagues and students on statistical methods for problems in cancer research, for example, on using patient characteristics for more accurate prediction and classification of disease outcomes, for improving the design and analysis of clinical trials, and for personalized prediction of treatment outcomes.

“It is wonderful to work with many students, graduate or undergraduate, as this Department gives them both a solid mathematical foundation and experience with current computational techniques. I am happy to be a helpful contributor to their learning processes. The curiosity and enthusiasm of students motivates me to keep improving in both my teaching and research.

“I am proud to have been, since 2008, part of the rebuilding of the statistics program at Queen’s, working hard with my colleagues through many explorations. The number of students majoring in statistics at Queen’s has increased from below 10 to more than 100 today. I am also very grateful for the support I receive in this department from colleagues and staff. Their encouragements and constructive advice have helped me cope with the challenges in work and life over the years."

THOMAS BARTHELMÉ
PROMOTED TO ASSOCIATE PROFESSOR

“I am honored by this promotion and looking forward to many more years working with my colleagues in the department and teaching our students.

“I joined Queen's in 2016, after receiving my Ph.D. in Strasbourg (France), and holding post-doctoral positions in Neuchâtel (Switzerland), Tufts University and Penn State University (USA).

“My research has been in-between Geometry, Dynamical Systems, and Geometric Topology. A particular focus in the past few years has been to try to classify certain hyperbolic dynamical systems as well as understand the relationship between topology and (hyperbolic) dynamics: given a three-dimensional manifold, what features of its topology can be deduced from the existence of a hyperbolic dynamical system?

“And vice-versa, given a hyperbolic dynamical system, what finer dynamical features can be deduced from the ambient manifold topology?”

On the right, Thomas with his son, Loïc, enjoying one of nature‘s gentle dynamical systems.

BRAD RODGERS
PROMOTED TO ASSOCIATE PROFESSOR

“I am lucky to work at Queen's on questions related to number theory, analysis, and probability; several other faculty here work on similar topics. I have been especially interested in how discrete systems, like the sequence of prime numbers, seem to inevitably exhibit randomness and disorder once one moves beyond the first patterns noticed about them.

“For instance, by examining tables it was noticed by the mathematicians Gauss and Legendre over two hundred years ago that once sufficiently zoomed out, prime numbers exhibit a regular pattern as one goes up the number line: the frequency of prime numbers appearing around an integer N is inversely proportional to the natural logarithm of N. This is a very surprising pattern, but perhaps even more surprising: after this pattern is found, the primes appear to be essentially as random as possible!

“At least conjecturally, this randomness can be described in an exact way. In fact, such a dichotomy appears in many parts of math and science but proving that some given mathematical or scientific object behaves randomly apart from an easily identified first structure is almost always very challenging.

“I've also been interested in how polynomials distribute, properties of matrices with entries that have been randomly filled in, and in recent work a type of random path called fractional Brownian motion. This last topic was famously investigated by Benoit Mandelbrot in order to describe phenomena in nature like flood levels of a river. It ends up also being related to the distribution of integers which have no repeated factors in their factorization!

“I have been fortunate at Queen's to interact with talented and inquisitive mathematics students at all levels. I hope to continue looking into questions in mathematics that bridge different parts of the subject, and perhaps also now to venture into new topics as well.”

NORIKO YUI
CMS FELLOW

Congratulations to Noriko for her appointment as a Fellow of the Canadian Mathematical Society. Noriko is also a Fellow of the Fields Institute.

Noriko describes herself as a mathematician and a physicist. But to focus more narrowly, I'll let her tell the tale.

"These days, my main interest is in the interface of number theory and string theory (mirror symmetry). In particular, I am trying to confirm the Langlands Philosophy for certain classes of Calabi-Yau manifolds defined over number fields. The dimension one Calabi-Yau manifolds are elliptic curves, and the theorem of Wiles et al. asserts that elliptic curves defined over the field of rational numbers are all modular. The dimension two Calabi-Yau manifolds are K3 surfaces.

"For certain classes of K3 surfaces, we have established the modularity results. The dimension three Calabi-Yau manifolds are Calabi-Yau threefolds, and these are the subjects of interest by string theorists as well as mathematicians. My main interest is to establish the modularity result for some of the Calabi-Yau threefolds defined over the field of rationals. For the so-called "rigid" Calabi-Yau threefold, the modularity has been established, and my current interest (and also of string theorists) are Calabi-Yau threefolds with Hodge type (1,1,1,1)."

JOHANA NG
Retires as Program Assistant for Mathematics & Engineering after 36 years

In July 1986, Johana joined the Department as a maternity leave replacement. A year later the Apple Math secretary position became available, and Johana was appointed to the position that she held for 36 years.

The Math & Stats Department has a complex administrative structure. We run three undergraduate programs: Mathematics, Statistics, and Mathematics and Engineering, and as if that weren't enough, we have the graduate program as well. The first two are in the Arts & Science Faculty, the third is in Engineering and Applied Science, and the fourth is in the School of Graduate Studies and Postdoctoral Affairs.

With all that going on, you can imagine that it takes skilled administrators to keep all the trains on the right track. Fortunately for us profs, we have a remarkable team of long-term Program Assistants. For most of those 36 years, Anne, Johana, and Jennifer have worked together as the three Program Assistants. There is no doubt that their longevity is a tribute to their skills in communication and administration.

L to R: Johana, Serdar Yüksel, Troy Day. Jeananne Vickery, Peter Taylor, and Howard, Johana's husband.

JEN POWELL
MTHE PROGRAM ASSISTANT

Born in North Bay and raised north of the city, Jen moved to the Kingston area in 2004 to begin her career at Queen's. In her free time, she enjoys gardening and raising backyard chickens and turkeys.

SEAN DOUGHERTY
MTHE PROGRAM ASSOCIATE

"I am excited to begin my year as Program Associate for Mathematics and Engineering. I completed both my undergraduate and master's degrees with the Department of Chemical Engineering in 2011 and 2013, respectively.

"However, all engineering students are shaped by the Math and Stats Department to varying degrees. I still remember Leo Jonker teaching first-year calculus and being amazed by his ability to draw any three-dimensional object on an overhead transparency with ease. In grad school, I was a member of the process controls group and so I spent many hours in the basement of Jeffery Hall both taking courses and preparing for tornados.

"For the past nine years, I have worked for small technology companies in Kingston. Most of my experience has been in the space industry, building and operating bone cell incubators used on the International Space Station. The balance of my experience has been as a "utility player" who bounces between manufacturing, operations, and sales. Outside of work, I love to cook, and I am an avid practitioner and coach of Brazilian Jiu Jitsu. I have always admired the Apple Math program, and I am excited to have the opportunity to work with such a talented group of students, staff, and faculty."

L to R: Tony Toffolo, Chris Wellstood, Jesse Van Vlack and Sean Dougherty

FAREWELL TO RIANNA

RIANNA LEWIS DEPARTMENTAL & FINANCIAL ASSISTANT

Rianna has stepped down after four years with the Department.

Rianna has taken the position as Research Administrator in the Department of Emergency Medicine –most certainly a challenging place to be in today's world.

Good luck to Rianna—we miss you!

WELCOME TO ISRATE

ISRATE AFROZE DEPARTMENTAL & FINANCIAL ASSISTANT

"I always really wanted to work in the academic environment. Previously, I worked as an Engineering Administrator at Canada Royal Milk, developing and improving critical work processes. I had a time in Germany working in market research and quality analysis at GfK and I learned to speak German.

"As a statistics graduate from Jagannath University, I am thrilled to be a part of Queen's Math and Stats department. Apart from work, I love photography, exploring nature and playing badminton."

Very happy to have you here!

MAHDI MOHEBBI
ADJUNCT INSTRUCTOR

Mahdi has been trained as an engineer with degrees in Mechanical Engineering. His research, however, has been (and currently is) in mathematical physics and partial differential equations. He is particularly interested in the phenomenon of resonance in interactions of solid and elastic bodies with continuous media. Specifically, such investigations have applications in design and optimization of energy conversion systems via mechanical interactions, such as wind turbines or ocean wave energy harvesting systems.

Prior to joining Queen's, Mahdi was an Assistant Professor in the Department of Mechanical Engineering at the State University of New York. At Queen's, he is primarily engaged as an instructor with the Mathematics and Engineering Program.

FEAS TEACHING AWARDS
FADY ALAJAJI AND ALAN ABLESON

As many of you will know, first year students in the Faculty of Applied Science and Engineering (FEAS) have a common first year, and do not start their specializations until Year 2. In that first year they take three math courses, APSC 171, Single-variable Calculus, APSC 172, Multi-variable Calculus and APSC 174, Linear Algebra. These three courses are jointly staffed by the two Faculties, Applied Science and Engineering (FEAS), and Arts & Science (FAS).

FEAS has a number of teaching awards and this past year two of our faculty members were recipients.

Fady Alajaji was the recipient of the FEAS Leadership in Teaching Award. This award celebrates general contributions to teaching excellence among the faculty as a role-model and mentor.

Fady teaches and coordinates the first-year linear algebra course (APSC 174) as well as the advanced information theory course for the “AppleMath” program.

In the Fall (2021) Alan Ableson won the FEAS First-Year Teaching and Learning Award for his work with APSC 171. Alan is both an instructor and the coordinator of the course. This is an interesting course to teach as the students, almost all of whom have taken calculus in grade 12, think at the beginning that they’ve seen it all before. They certainly find out quickly enough that there’s tons of new stuff, and indeed a new way of thinking about calculus. But for some that realization comes late.

The previous year (2020-21) Alan was a recipient of the FEAS Leadership in Teaching Award described above.

Alan is a member of the Department of Mechanical and Materials Engineering and is cross-appointed to Mathematics & Statistics.

STUDENT AWARDS

ADAM GRONOWSKI
CSIT PAPER AWARD

Master's student Adam Gronowski received the Canadian Society for Information Theory (CSIT) Paper Award for the best paper accepted at the Seventeenth IEEE Canadian Workshop on Information Theory, Ottawa, June 5-8, 2022.

The paper is entitled *Rényi Fair Information Bottleneck for Image Classification* by A. Gronowski, W. Paul (APL, Johns Hopkins Univ.), F. Alajaji, B. Gharesifard and P. Burlina (APL, Johns Hopkins Univ.). The Award consists of a certificate and a $1000 prize.

"Apple Math was the ideal program to begin a career in machine learning research. One reason why I chose Apple Math was because it was interdisciplinary and a mix of both theory and applications – you learn rigorous math just like math students do but also learn things from the more applied, practical engineering side. Machine learning is the same – you have to do theoretical, mathematical work but also be able to apply it to produce useful results with real datasets. Apple Math gives you the skills to do both, covering all the mathematical topics necessary to understand machine learning, such as calculus, linear algebra, probability, and information theory, but also giving you more practical coding skills through computer science courses such as data structures and algorithms.

"My first introduction to machine learning was through a summer research position after my 3rd year of undergrad, an NSERC USRA with Prof. Alajaji. I worked on applying the information bottleneck method to deep learning. This was a very interesting project as deep learning is still a nascent field and much about how it works remains unknown, providing many directions for research. This led me to continue work in the field with an undergrad thesis with Prof. Alajaji and a Master's supervised by Profs. Alajaji and Gharesifard.

"Currently I am working on applying information-theoretic techniques to develop methods to improve privacy and fairness in machine learning. This is a great opportunity to use my math background to help solve pressing social issues and achieve social benefit. I enjoy the interdisciplinary aspect of the work, using math together with computer science and even some medicine as we work on medical datasets, as well as being able to collaborate with top people like Profs. Alajaji and Gharesifard, and Dr. Philippe Burlina from Johns Hopkins.

"Outside of work, I enjoy travelling – during my third year of undergrad I spent a semester on exchange at NTU in Singapore, experiencing a different culture and travelling all over Southeast Asia, with highlights including climbing Mt. Fuji in Japan and jungle trekking with wild orangutans in Indonesia. I also love being outdoors in the mountains, especially rock climbing, hiking, or skiing."

SOPHIE JOHNSTON
THE IRENE MACRAE MATH & STATS SCHOLARSHIP

Established in April 1986 by Margaret Crain in memory of Irene MacAllister MacRae, Arts 1914, who was vice-president of the Mathematical Club while at Queen's. Awarded on the basis of academic excellence to a student graduating with a BA (Honours) degree or a BSc (Honours) degree with an academic plan in Mathematics or Statistics.

"The natural world has always been a great mystery that inspired many questions and sparked my curiosity about biology as a child. The answers to these questions seemed complex and near impossible to establish, but I now know the right tools and skills in research, data analysis, and biological modeling bring us one step closer to solving some of the most crucial environmental issues across the globe.

"In high school, I learned about the Fibonacci sequence and the Golden Ratio, and how these and other important mathematical concepts can contribute to the beauty and complexity of our environment. Since then, I have been intrigued by how we can use mathematical concepts to explain and parse out nuanced patterns observed in nature.

Sophie and her fellow Biomath students—the "Biomathletes."

"I was incredibly lucky to have attended Queen's University as the Biology and Mathematics specialization allowed me to experience and study the best of both worlds —from calculus and statistics to ecology and biochemistry. This program has propelled me forward into my Master's studies at UBC started this fall, where I am studying marine biology in the Zoology program. I hope to use my skills in statistics and applied mathematics to help solve complex, modern environmental problems we face today.

"Throughout my undergraduate studies, it became clear to me that every biologist I knew used mathematics in their research. Studying both biology and math has given me the tools to answer some of those persistent questions I had as a child that continue to develop as I grow older."

LUCA SARDELLITTI
THE DEAN'S SCHOLARS AWARD FOR THE HIGHEST GPA IN A DISCIPLINE

"Ever since I was young, I was always interested in math and software engineering. I chose to come to Queen's specifically because of the mathematics and engineering program, which allowed me to pursue both of my interests simultaneously.

"Looking back on my undergraduate career, I know I made the right choice! I am very appreciative of the experiences I had here, which were fostered by the incredible sense of community throughout the university, department, and program.

"The rich academic course load offered by the Department and delivered by the professors gave me a deeper understanding of mathematics and engineering. In addition, I gained many other experiences through various activities offered through Queen's, including design teams such as QSORT and QMIND, an undergraduate summer research assistantship with the Math Department, and a year-long professional internship in software engineering.

"These experiences helped me realize that what I enjoy most is learning new things, making me determined to pursue further studies. This fall, I am continuing my journey at Queen's toward a M.A.Sc. with the Mathematics Department. I am excited to continue my academic career here and spend more time as a part of this amazing Faculty!"

M.AWNI ALTABAA
THE ANNIE BENTLEY LILLIE PRIZE IN MATHEMATICS

Awarded to a graduating student in Mathematics and Engineering who has the highest average on courses in Mathematics in the final year.

“I had a great time in the Mathematics and Engineering program—I transferred to Queen's in my second year of university specifically because the program interested me. I am most grateful to the faculty at the department for the wonderful mentorship I received during my time here!

“I think mathematics is a special field. It gives us a way to understand the world at the deepest possible level. What gets me most excited is doing research and expanding the Lebesgue(!) measure of the set of things we know. I hope to ultimately find a career in research. This fall, I started my Ph.D. at Yale in the Department of Statistics and Data Science to take the next step towards that. One area that I am interested in working on is developing the mathematical theory of artificial intelligence (a fascinating field that I think would benefit from more math)!

“My time at Queen's helped shape me as a researcher and as a person; for that I will forever be grateful. I hope to come back and visit someday.

“Otherwise, I play soccer when I get the chance and a couple of years ago, I started learning the piano. I enjoy putting on a pair of earphones and going for an evening walk, I find that very relaxing.”

At right: Awni on a hike last fall close to Kingston.

ANJI DENG
MEDAL IN MATHEMATICS AND STATISTICS

Awarded to the graduating candidate who has demonstrated academic excellence in an honours degree who is deemed by a Department to have achieved the highest standing in a Plan offered by that Department.

Anji writes: “I had a great time at Queen's University, especially for all the amazing professors and courses in Math and Stat Department.”

JAMES ZHU
UNIVERSITY MEDAL IN MATHEMATICS AND ENGINEERING

The University Medal in Mathematics and Engineering is awarded to a student who has the highest Grade Point Average for all courses of the third and fourth years.

“Admittedly, I was initially hesitant to attend Queen's. Being a Kingston local (having been born and raised here, even being born on campus at KGH). Thankfully, after looking back at my four years here, I can definitively say that attending Queen's and joining the Apple Math program has been one of the best decisions of my life.

“At Queen's, I have been blessed to be surrounded by such bright, hardworking, and passionate peers and friends. Highlights for me include being a leader for the Engineering Orientation week (AKA a FREC) and leading tutorials as a TA for APSC171 and APSC174. I also clearly recall nights hanging out with friends and chatting about life, school, and (most importantly) how to do homework questions!

“Currently, I am working in Toronto as an embedded software developer at Pulsenics Inc., a start-up company managed by an Apple Alumnus. I will work here for a year, after which I will join the University of Toronto's Electrical and Computer Engineering department for my Master's under the supervision of Dr. Frank Kschischang. My research will be in the area of communication, coding, and information theory. I have always been fascinated with tackling complex engineering programs in the language of mathematics and I believe joining UofT's Communication group is the perfect fit for me.

“Afterwards, I plan to pursue a Ph.D. with the end goal of joining academia as a professor and guiding the next generation of great thinkers. Who knows, maybe one day life will take me back to Queen's as an Apple Math prof!

James with Fady Alajaji

“Thank you to my friends and family for all the support throughout these years. Particularly, thank my mom and dad for not only coming to Canada to give me a better life and better opportunities but for also taking care of me throughout my life (including the one year I stayed home due to COVID and online school).

“I would also like to thank my housemates throughout the years for making sure I took care of myself and for reminding me to take the time to have fun and enjoy my undergraduate experience. Last but not least, thank you to all of my brilliant classmates and teachers in Apple Math who inspired me to do my very best. “

ALI KARA
THE 2022 CECIL GRAHAM DOCTORAL DISSERTATION AWARD

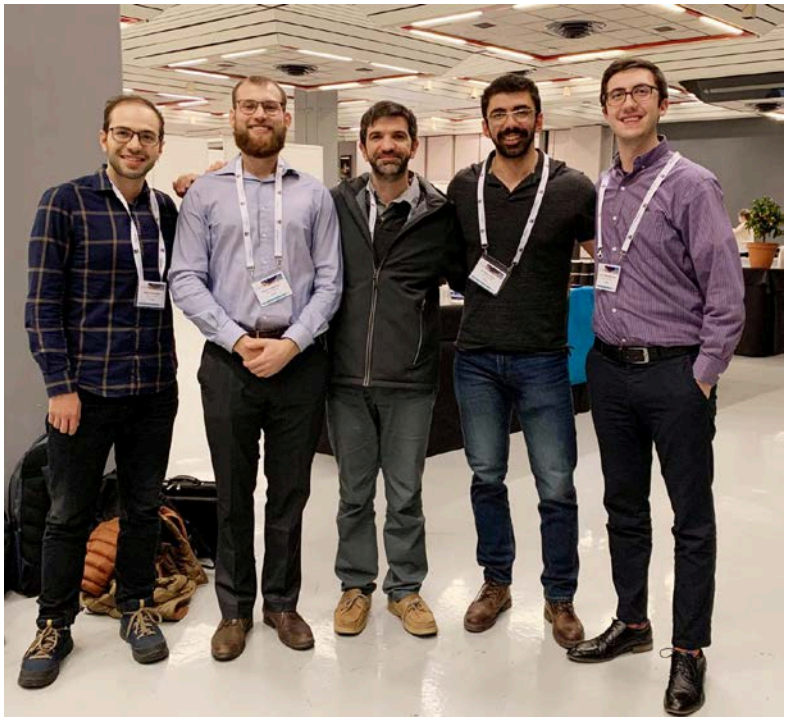
Dr. Kara completed his Ph.D. at Queen's in 2021 under the supervision of Serdar Yüksel. The award consists of a prize of $1000, a commemorative plaque and an invitation to speak about his work. Ali received his award at the June 2022 CAIMS meeting held at UBC Okanagan, where he spoke about his results concerning **Near-Optimality of Finite Memory Approximations for POMPDPs**.

"Coming from an engineering background, I wasn't so sure how I'd do in a Math department. In my first year at Queen's, I completed a course-based master's degree, during that year, the courses I took (specifically by James Mingo, Francesco Cellarosi, Ram Murthy, Tamas Linder, Fady Alajaji and Abdol-Reza Mansouri), and the friendship among other graduate students helped a lot with my transition and made my grad school experience enjoyable.

"Serdar's Research Group met weekly and I'm sure that gave me a highly productive and fruitful grad school experience. I remember the first meetings were quite challenging, and by the end of our studies, we managed to develop a common research language and a culture. Serdar has a broad research portfolio and provided us with interesting and wide-ranging research directions.

"Currently, I am a Research Assistant Professor in the Department of Mathematics at University of Michigan. I am still in contact with the people from Queen's, and we still discuss our research problems with each other, I hope this collaboration and friendship will last a long time."

Serdar's research group 2020-21
Left to right:
Sina Sanjari
Bora Yongacoglu
Serdar Yüksel
Ali Kara
Curtis McDonald



EVENTS

QUEEN'S GLOBAL SUMMER 2022

This past summer the Queen's Global Summer (QGS) held a six-week interdisciplinary on-campus summer program. Informed by the **United Nations Sustainable Development Goals** (SDGs), QGS offered a mix of courses, workshops, retreats, cultural events and lectures based on issues of global significance, from gender equality to sustainable communities and more. Through this unique multidisciplinary approach, the objective was to raise awareness of global challenges and facilitate campus-wide conversations on these.

One of the speakers in the Sustainable Freedom Lecture Series was **Felicia Magpantay**, an Associate Professor in the Department of Mathematics and Statistics at Queen's University. She talked about:

Mathematical Modeling and Public Health
Mathematical modeling is a powerful tool for studying complex systems. Recently we have seen many of its applications in designing public health strategies during a pandemic. In this lecture we discuss some of the history behind mathematics applied to public health and point to some open research problems.

Felicia's research includes differential equations, applied dynamical systems and mathematical modeling with applications focused on ecology and epidemiology.

*Along with this lecture, Felicia ran a **Workshop on Mathematical Ecology Modeling Epidemics***

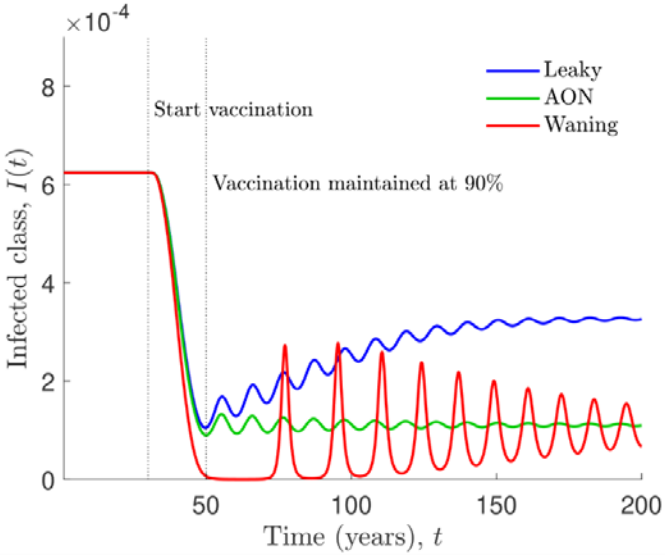
Felicia's lecture looked at the effect on the proportion of individuals infected (vertical axis) over time (horizontal axis) with vaccines of different types of effectiveness.

Leaky: only partial immunity at all times.

AON (all or nothing): Vaccine either has full immunity over a long period (in some) or has no effect at all (in others).

Waning: Full immunity when given but that tails off over time.

The last one is interesting. We get a sequence of spikes with decreasing amplitude and period settling down to a more constant endemic state.



THE L. LORNE CAMPBELL LECTURESHIP

The L. Lorne Campbell Lecture was held November 24, 2021. Even though at that time most classes were meeting in person at Queen's, the difficulties of travel forced us to hold the event online. Both Lorne Campbell and Vijay Bhargava (colleague of Lorne's and long-term supporter) were in attendance.

The speaker was Peter Sarnak of the Institute for Advanced Study and Princeton University. He is the Eugene Higgins Professor of Mathematics at Princeton since 2002 succeeding Andrew Wiles who is best known for his solution of Fermat's Last theorem.

Peter is known for his deep results in analytic number theory—the branch of mathematics that uses analysis to establish results about integers.

One of the best-known results of this type is perhaps the prime number theorem which estimates the number of prime numbers less than any given number *N*. It says that the proportion of numbers less than *N* that are prime is asymptotically close to $1/\ln(N)$. For example, the natural logarithm of a million is about 13.8155 and the reciprocal of that is about 0.072382 so there are about 72,382 primes less than a million. In fact, the actual number is 78,498. This might not seem like a good estimate, but the result is asymptotic and a million is a small number (and getting smaller every day).

Some of the participants at the 2021 L. Lorne Campbell Lecture.
(1, 3) Peter Sarnak (1, 4) Troy Day
(2, 1) Lorne Campbell (3, 2) Vijay Bhargava
(5, 1) Thomas Barthelmé and Clara (class of '41)

COMAP MATHEMATICAL CONTEST IN MODELING

COMAP (the Consortium for Mathematics and its Applications) runs a Mathematical Contest in Modeling (MCM) every year and the dates this year were Feb 17-21.

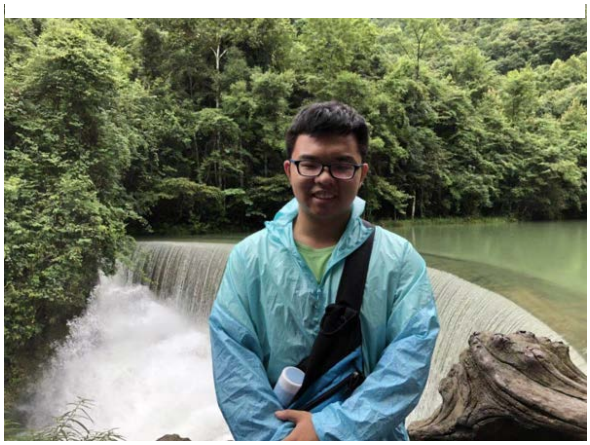
This is an opportunity to take part in an international contest and interact with team members—a team can have up to 3 students, but each institution is allowed several teams. During the competition each team researches, models, and writes a 20-page solution to an open-ended real world modeling problem. On the opening day, teams are given three problems from which they are to choose one. This year the problems were

A. Determine a method to approximate the ideal way for a cyclist to ride a fixed course in the least amount of time.

B. Develop a mathematical model to assist the natural resource officials in finding the best way to manage water usage and electricity production at the US Glen Canyon and Hoover dams.

C. Given five years of data on gold and bitcoin prices, develop strategies on how to trade an initial $1000 stake using only the data up to the date of each trade.

Abdalkarim (above) and Tangbufan (below) both visiting a waterfall!



Brynja enjoying a favorite activity

This year 15,105 teams representing institutions from 22 countries/regions participated in the contest. Queen's has not participated in this, at least not for a long time, but this year we were lucky to have a sabbatical visitor, Brynja Kohler from Utah State University, whose field is Mathematical Modeling. Brynja brought this contest to our attention and offered to be the team advisor. She sent out an invitation to our senior undergraduates, and Queen's fielded two teams. Starting in January, Brynja met regularly with the team for intense training and the Queen's results were:

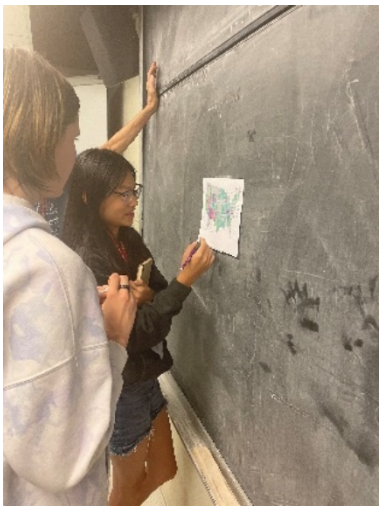
Team 1: Tangbufan Wei and Abdalkarim Alnajjar – HONORABLE MENTION!

Team 2: David Griffin, Janelle Lee, and Alyssa Green – SUCCESSFUL PARTICIPANT!

Fourteen Canadian teams chose problem C, but of these there were only 3 honourable mentions, the other two from McMaster. Other Canadian teams that achieved Successful Participant are from Waterloo, McGill, UofT, UBC (2), Ontario Tech (2) and McMaster (3).

MATH QUEST—OUR GIRL'S SUMMER MATH CAMP August 2022

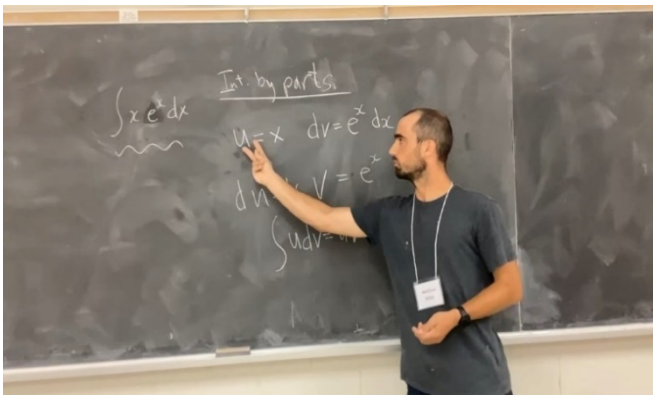
After 2 years of covid cancellations (we didn't feel that an online camp would really work), Math Quest sprung to life again—four days of games, mathematical stories, and campus life.



The culminating activity was our all-day escape room with two teams racing to navigate a sequence of cryptographic trials. The goal of the escape room was to liberate Mike Cabral, Camp Director, who was trapped in an unknown Jeffery Hall room. By following 3 levels of clues the students finally retrieved a critical 10-digit phone number which gave Mike his freedom.

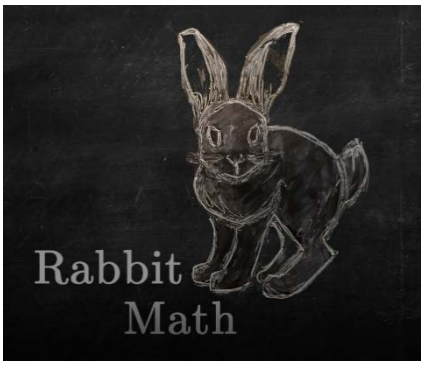
At the right the girls are colouring a map in which the colours correspond to words on a list needed for the hidden message. The day before, Somya Singh, Instructor, had been working with the 4-colour theorem.

As the girls drew near to the final step they managed to unlock the password to open a critical video which they watched with huge anticipation. But what was this!—one of Mike's calculus lectures on integration by parts. What on earth are we to do with that?



It turns out that every time Mike pointed to an equation he used American Sign Language and all the symbols put together spelled out the hidden message. For example, at the right he is signing "K". It took a while for each team to catch onto that, but when they did there was a huge rush up the full 5 Jeffery Hall flights of stairs to get to the ultimate prize in the conference room.

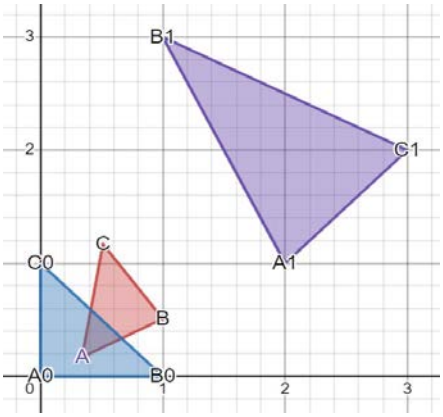
RABBITMATH GRADE 7-8 SPRING CAMP



While we have run a number of camps at the high-school level, this was our first venture with grade 7-8. This was a 3-day camp with many of the campers from the GTA. We used high-school problems but in a format that was active and that encouraged play. We were most impressed with the capacities of the students and found them to be capable of many tasks that would be regarded as beyond their grade level.

We learned a number of lessons from the feedback, and we will have a much better handle going forward on the interests and abilities of kids at that stage.

One important lesson was that kids at that age need to "change-up" quite a bit, not only new problems, but also new environments, pencil and paper, diagrams, screens, manipulatives (dice), data collection, etc.



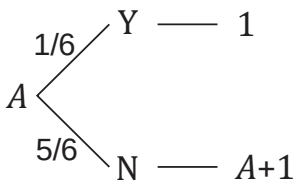
We spent some of the time playing with Desmos, a graphical calculator that is capable of building some neat animations, and many of the kids were quite adventurous in the structures they tried to play with. Some reported that they used Desmos in the classroom but had never played with it and had never built animations.

This reaction to the idea of play was much more general than Desmos. "Play" in math class was a new experience for most of them. For example, they had rolled dice before and knew that the probability of rolling a 3 was 1/6th, but they had never really "played" with the dice in a mathematical way. For example:

How many rolls are needed on average to get your first 6?

We began by collecting data and plotting the results. This was new to them. and they got quite engaged. Of course, this would normally be considered a grade 12 problem (Data Management) but the RabbitMath philosophy is that the "active" parts of that problem are perfect for a much lower grade level. In fact, the students seemed quite comfortable with the idea of using the data they had gathered with the dice to calculate an empirical estimate of the average number of rolls.

And then, of course, there was a discussion of how we might calculate the *theoretical* value *A* of the average. For example, they were able to find the probability of getting that first 6 in one roll, and in two rolls and in three rolls… etc. and then they talked abut about how to formulate and even evaluate the average of that infinite collection of possibilities.



But then we rolled out that elegant one-line recursive argument:
Roll the die once. Then what have you accomplished in your journey toward that first six? Well maybe (p = 1/6) you have got your six and it took you 1 roll. Otherwise (p = 5/6) you have made no progress at all, and you are back where you started (with A rolls on average to go) but you have made one roll already. We capture this in the simple recursive equation at the right, which solves to give A = 6.

$$A = \frac{1}{6}(1) + \frac{5}{6}(A+1)$$

PI DAY MARCH 14, 2022

The university was abruptly shut down in early December 2021, right at the start of the December exams, and it did not open again until Feb 28. In a sense that was good news for Pi Day as there were students around who could gather in the Jeffery Hall lobby and celebrate the occasion.

But what do you do on Pi Day when no-one is allowed to take off their mask? You can't stand around chatting with fellow students while eating your piece of pie.

That was the problem faced by Adeline Young, our DSC co-president. To meet this challenge, she approached her grandmother, who was a master crocheter, and asking her for help in baking (actually "making") a bunch of pies. Adeline herself stepped up to the pi-plate and, in no time, they had a hundred pies with a full range of flavours.

Some 80 of them were sold providing good funding for the real pies to come next year and many years after.

L to R: Winnie Kwong, Adeline Young, and Naz Gulsen (DSC co-president).

Queen's UNIVERSITY **Mathematics and Statistics**

Queen's Mathematical Communicator
Department of Mathematics and Statistics
Queen's University
Kingston, Ontario Canada K7L3N6

Queen's Mathematical Communicator
Editor: Peter Taylor
mathstat@queensu.ca
queensu.ca/mathstat/

If you are a Queen's Math & Stats or Math and Engineering graduate and are not receiving notification of this publication, our alumni records might not have your email address. You can update that information by emailing records@queensu.ca.