QUEEN'S MATHEMATICAL
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WELCOME FROM THE HEAD, JAMIE MINGO

Every few years a new technology arrives and society has to pass through a phase transition. Twenty years ago, it was the internet, then more recently, smart phones, big data, machine learning and AI. After the new technology has been mastered, we look back and wonder how we managed without it. However, each new wave brings a new division between those who can exploit the new technology and those who feel exploited by it. The big challenge of Queen's is helping our students become leaders in these new technologies so that they can have their say on their development and use.

For many years, the Department has had a joint undergraduate program with the School of Computing on Computing and Mathematics. The program has become more popular over the years and the Department has worked with the School of Computing over the last year to revise the program. It will be called Computing, Mathematics, and Analytics to reflect the new focus on big data and machine learning. Moreover, these areas will be a part of our search for two new faculty members to start next year.

In the past twelve months, the Department has had two separate reviews of its programs. The first, called Queen's University Quality Assessment Process (QUQAP) is a provincially mandated review of all of our degree offerings. We had two external reviewers come in February to study all aspects of our program delivery. This involved meetings with many students, staff, faculty, both within and outside the Department, as well as the senior administration of the University. This was a very valuable process, and the outcome will guide the Department in the next few years as we update and modify our programs.

The second review was by the Canadian Engineering Accreditation Board (CEAB), which is an arm of Engineers Canada. The CEAB review ensures that students in our very popular Mathematics and Engineering program meet the requirements to become licensed engineers. In this review, we received the highest evaluation offered by the CEAB, and the program has been renewed for the next six years. The Mathematics and Engineering program is now the third most popular (based on enrollment in second year) of the ten engineering programs at Queen's. It is challenging, rigorous, and very interdisciplinary.

We are pleased to welcome two new faculty members: Catherine Pfaff and Brad Rodgers. They are profiled later in this issue.

The Department has launched two new distinguished lecture series called the Fields@Queen's Distinguished Lecture and the Lorne Campbell Lectureship. The Fields@Queen's Distinguished Lecture is a joint initiative with the Fields Institute for the Mathematical Sciences in Toronto. It will take place in the winter term and the first lecture was in March 2018.

The L. Lorne Campbell Lectureship honours the work of Lorne Campbell who was a professor in the Department from 1963 to 1996 and Head of Department from 1980 to 1990. Lorne was a Canadian pioneer in the burgeoning field of communications theory. Through his scientific work and that of his students, Queen's is now a centre of teaching and research in communications theory. The Lectureship was made possible through the generous donation of Dr. Vijay Bhargava, a former student of Queen's University.

July 2018 marked the retirement of David Thomson from the Department. David has taught and researched in the statistics of solar fluctuations at Queen's since 2002. The Department hosted a conference on his work in late August 2018. In the next issue of the Communicator his work will be the subject of a faculty profile.

It is with sadness that I have to report that Ian Hughes died earlier this year. Ian joined the Department in 1968, and became well known for his probing intellect, his wide-ranging concerns and his active compassion. An account of his 50 years with us at Queen's appears in this issue. He will be missed by his students and colleagues.

Jamie at
Pi day 2018

FEATURE ARTICLE: GREG SMITH

Greg did his undergraduate work at Queen's in the early 90s. From Queen's he went to Brandeis to study for his MA and he completed his PhD at UC Berkeley in 2001. Following his PhD, he was a Clay Mathematics Institute Liftoff Fellow and an Assistant Professor at Barnard College, Columbia University. In 2004, we were fortunate to get him back to Queen's.

Early in his career, in 2007, he won the André-Aisenstadt Prize and five years later, in 2012, he won the Canadian Mathematical Society Coxeter-James Prize that recognizes young mathematicians who have made outstanding contributions to mathematical research. He will spend the coming year (2018-19) as the Knut and Alice Wallenberg Foundation Visiting Professor at the Royal Institute of Technology (K.TH) in Stockholm.

RESEARCH

(extracted from kaw.wallenberg.org/en/gregory-g-smith)

Greg's research lies in the field of algebraic geometry – the study of solutions to systems of polynomial equations – a branch of mathematics with roots far back in human history. A 17th century milestone was the invention by René Descartes of the coordinate system, thus providing a link between algebraic equations and geometric objects, allowing the methods used in geometric reasoning to be used to solve algebraic problems.

Today's algebraic geometry is a broad field of study with branches in many areas and deep interactions with other parts of mathematics. It also interacts with the string theory of theoretical physics and on a technical level, with aircraft construction and robotics.

Greg's main research interests lie in a relatively new area of algebraic geometry called toric geometry, situated at the boundary between algebra, geometry, and combinatorics. Thanks to newly developed geometric and combinatorial methods, this work might simplify algebraic computations that had previously been extremely challenging or entirely inaccessible. Conversely, new methods in algebraic geometry may turn out to be useful in proving theorems about geometric objects.

INTERVIEW WITH GREG

(Peter Taylor)

I had a chance to chat with Greg about his teaching and his life at Queen's. He noted that over the past few years mathematics enrolments (majors and medials) at Queen's have soared, so much so that, with our current faculty numbers, we are having a hard time meeting the demand. We are of course being given appointments at a higher rate than any other departments (4 in the past two years!) but we are still falling behind the increase. This phenomenon is being experienced at other Ontario universities, but the reasons for it are unclear. Certainly math is in the news, and it seems to be generally understood that if you can do mathematics, at either the BSc or the MSc level, you will be able to meet any of the creative challenges awaiting us in this rapidly evolving technological world.

We also see this increased enrolment in our service courses which are often not a requirement in the student's program. This happens even at the 300 and 400 level, and when class sizes get too big (over 100) that can be a challenge in scheduling such things as projects and presentations.

Greg was Chair of Undergraduate Studies for a few years and I asked him about that experience. He enjoyed most the interaction with students; often they came with problems finding the right program or the best course to take, or whether a prerequisite was really needed, and even, how do they go about getting a letter from a professor.

I asked Greg why he chose mathematics as his field of study and his wonderful reply was "It chose me"! He says it was his encounter with algebra that convinced him that mathematics,

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rather than physics, was his destiny. He cited the clean elegant but sophisticated structure of the subject that filled him with joy. He enjoys teaching MATH 110 (linear algebra) because unlike calculus, it is something completely new for the students.

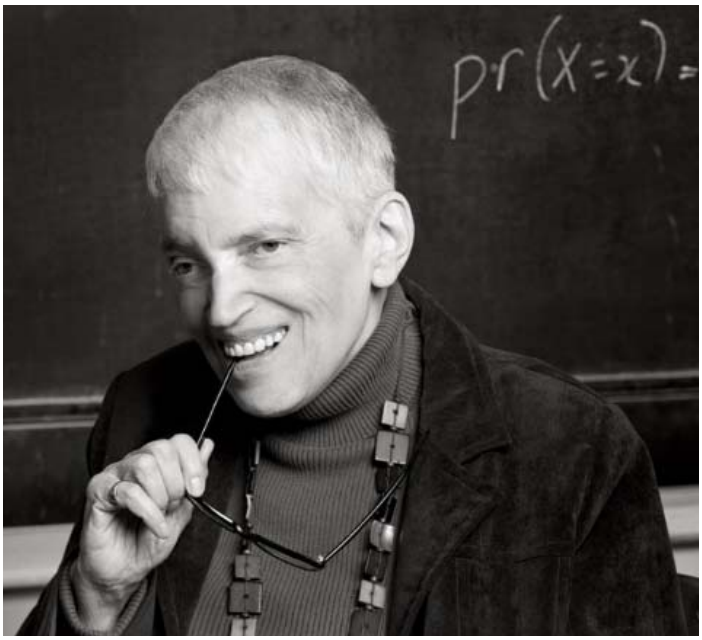
Greg enjoys hiking and downhill skiing. He always walks to work catching up on his favorite podcasts. He enjoys reading fiction. Fiction is also my preferential genre but currently I am reading a book that tells the remarkable Pixar story and Greg recounted how, when he was a student at Berkeley, the Pixar folks used to come and give colloquia about how there were finding different ways to use the power of mathematics to produce life-like effects for their computer animations, like how to create the reflection of light off water, or a rich head of red hair waving in the breeze.

wired.com/2012/06/pl_bravehairtech/

AGNES HERZBERG

2018 UNIVERSITY OF SASKATCHEWAN HONORARY DEGREE RECIPIENT

Professor Emeritus Agnes Herzberg received an honorary degree on June 6th 2018 from the University of Saskatchewan. Professor Herzberg is a noted Canadian statistician and was cited for her work in the statistical design of experiments and her contributions to the design of clinical trials in medicine.



V. Tony Hauser

Dr. Herzberg received her BA at Queen's and then earned her PhD from the University of Saskatchewan. She began her academic career with a 1966 NRC Post-Doctorate Fellowship at Birkbeck College and Imperial College of Science and Technology, both part of the University of London. In 1968 she began a 20-year career teaching at Imperial College, with brief engagements at the University of California, Berkeley, University of Washington, and the Mathematics Research Center at the University of Wisconsin. She returned to Queen's in 1988 and was appointed professor emeritus in 2004.

Believing that individuals are enriched by exchanges with those in other disciplines, Dr. Herzberg introduced the idea of inviting scientists and others to statistical conferences. As a result she organized the Conference on Statistics, Science and Public Policy, held annually at Herstmonceux Castle in England since 1996. At the conference, which honours the work of her father, Gerhard Herzberg, winner of the 1971 Nobel Prize in Chemistry, a diverse mix of scientists, politicians, civil servants and journalists from many countries addresses significant policy issues. The conferences are summarized in proceedings that Dr. Herzberg edits herself.

Dr. Herzberg was the founding editor of Short Book Reviews, a publication of the International Statistical Institute. During her 26 years of editorship, the journal handled over 12,500 volumes. Her participation in the Statistical Society of Canada (SSC) included serving as the organization's' president (1991-92) and as a member of many committees. In 2008 she was elected to the Royal Society of Canada "for her pioneering contributions to statistics".

Dr. Herzberg continues to be active. Recently, she collaborated with Ram Murty on a paper examining the properties of the Sudoku puzzle, including its potential for data compression.

www.queensu.ca/gazette/stories/professor-emeritus-receives-honorary-degree-university-saskatchewan

Excerpts from the Queen's Gazette (July 10 2018)

WE WELCOME TWO NEW MEMBERS OF FACULTY

We are enjoying unprecedented growth in all of the departments undergraduate programs. Math and Statistics courses offered primarily to new mathematicians are also more popular than ever. Fortunately, over the past 4-5 years we have been able to hire at least one new faculty member each year.

CATHERINE PFAFF was appointed Assistant Professor on July 1 2018. Catherine graduated from the University of Chicago with a BA and received her PhD in Mathematics in 2012 from Rutgers University. While completing that degree she taught for a year at Bard College at Simon's Rock. She followed that with postdoctorates at the CRM in Barcelona, Aix-Marseille and Bielefeld and finally as the Ky Fan Visiting Assistant professor at UC Santa Barbara.

Her research explores group theory through geometry and dynamics, with a special focus on understanding all the ways one can deform the measurement of distance on a given object. Similar techniques have been used to study phylogenetic trees and her hope is that, in the future, she could similarly use such techniques to better understand systems for processing data.

After mathematics, her greatest passions in life are music, dancing, building communities, exploring nature, seeking beauty and truth, and her dog Pierre.

BRAD ROGERS was appointed Assistant Professor on July 1 2018. Brad graduated from Purdue University with a BSc and received his PhD in Mathematics from the University of California Los Angeles in 2013. He followed that with postdoctorates at the University of Zurich and the University of Michigan. His research interests include random matrix theory, analytic number theory, and the interactions between the two areas.

Outside of math he enjoys reading about history and philosophy. He's looking forward to having a waterfront to swim in during the summer months.

As soon as Brad accepted our offer, we got right in touch with the city about a new beach. They responded immediately and we now have an excellent swimming area off the old pier below Gordon-Brockington Hall, as well as an upgraded walk along the whole area. Do give it a visit at your next reunion!

Breakwater Park

50TH ANNIVERSARY OF THE MATH AND ENGINEERING PROGRAM CELEBRATED IN STYLE

Apple Math, the beloved engineering program for students with a deep interest in both mathematics and engineering celebrated its 50th anniversary at the Homecoming weekend last Fall. It was a different world when Queen's launched the program in 1967, a time that university historian, Dr. Duncan McDowell calls the 'Sputnik age' when the Faculty of Engineering and Applied Science was overhauling its programs to work more pure science and math into the curriculum. The logo above was designed by Professor Andrew Lewis to honour the occasion.

The new Dean of the Faculty of Engineering and Applied Science, Kevin Deluzio is our Apple Math alumnus. He explains that the program was set up so that students would get a deep experience in mathematics at the same time as they worked with traditional engineering disciplines. Indeed despite being a program offered by a mathematics department, the students graduate as engineers, and that makes the program unique in North America. It takes a particular kind of curiosity and ambition to be a good fit for the program. As Dr. Abdol-Reza Mansouri explains, "These are students who want to understand everything in depth and understand exactly where all the equations come from."

The program has continued to keep up with the times. At the time it was launched, graduates were likely to end up in big traditional engineering or technology firms like Bell-Northern Research, IBM or Inco. The landscape has changed with the advent of the start-up culture, 'Big Data', and the explosion of computing power, all which have created new opportunities. Now, students are as likely to pursue a career in small start-ups, finance, or research, as they are to work in established technology firms.

While Apple Math used to be one of the smaller engineering undergraduate programs at Queen's, the numbers have doubled in the last few years and remain healthy, so healthy in fact that we will be looking this Fall for a new member of faculty in mathematics and engineering.

The celebration was held at the University Club and ran from Friday evening till Saturday night. Three plenary speakers gave us their views on the history and significance of the program:

- Vijay Bhargava (*1970, Control and Communications*) Professor, Electrical and Computer Engineering, UBC)
- Kevin Deluzio (Sc'88, MSc'90, PhD'97) Dean Faculty of Engineering and Applied Science
- Siobhan Powell (*2016, Applied Mechanics*) PhD student in Mechanical Engineering, Stanford University)

Dr. Mansouri feels strongly that the alumni are key to the program's success, "I would like to tell our alumni that they should be proud to be associated with such a program and that the program is proud of them. I invite them to stay in touch, and we do our best to stay in touch with them as well."

50 YEARS
Mathematics and Engineering
QUEEN'S UNIVERSITY

PICTURES FROM THE 50TH REUNION (more pictures on next page)

Siobhan Powell (Apple Math 2016) addressing the reunion. She is currently doing graduate studies at Stanford working on research into mechanical applications in renewable energy.

50 YEARS
Mathematics and Engineering
QUEEN'S UNIVERSITY

PICTURES FROM THE 50TH REUNION

Karen Rudie (Professor Electrical and Computer Engineering and Apple Math 1985) Abdol-Reza Mansouri, Claire O'Brien (Department Manager), Jon Davis (Emeritus) chatting with an alumnus.

Abdol-Reza Mansouri and Fady Alajaji chatting with Lorne Campbell (Emeritus and Head 1980-1990).

Dean and Head: Kevin Deluzio chatting with Jamie Mingo

QUANTITATIVE ANALYSIS AND MODELING

Profs. **BAHMAN GHARESIFARD, DEVON LIN** and **SERDAR YUKSEL**, are working with the new Fields entre for Quantitative Analysis and Modeling. This centre was created by the Fields Institute with an injection of $4,000,000 from the Ontario Government. One of the first recipients of the new funding will be the Chemical Process Mathematics Lab (CPML) related to chemical process modeling, control, optimization and data. The lab will be located at Queen's, with collaboration from researchers at Waterloo, McMaster and Ryerson. The grant can be used to fund conferences and graduate students.

Bahman Gharesifard

Devon Lin

Serdar Yuksel

GOLD MEDALLISTS

Dave McLeod in front of the Berlin Cathedral on his way to take a postdoctoral position at ETH Zurich

DAVE MACLEOD (PhD 2017, Troy Day) wins the Governor General's Gold medal and the Cecil-Graham Doctoral Dissertation Award of the Canadian Applied and Industrial Mathematics Society (CAIMS).

The citation for the CAIMS award reads:

> *Dr. McLeod's thesis is a beautiful example of applied mathematics, applying sophisticated mathematical ideas to questions of fundamental interest to evolutionary biologists, relating to infectious diseases and mating systems, including sexual selection and conflict, and also addressing social interactions such as cooperation, altruism and spite, for example showing how small population size can drive the emergence of such behaviour.*

We asked Dave about his time at Queen's. He replied that he thoroughly enjoyed it and found it a great experience.

"Research-wise, I benefited substantially from interacting with the Queen's math bio group (led by Peter Taylor and Troy Day). They are both accomplished mathematical biologists, but remain committed to spending time aiding students/post docs to gain a more complete understanding of mathematical biology. Their approach, and the emphasis they placed upon learning, greatly enhanced my appreciation of evolutionary biology as well as the underlying mathematics. Additionally, because the members of the math bio group work on a diverse array of problems, from kin selection driven cooperation to infectious disease to evolvability, I found it easy to get exposure to a suite of different ideas and techniques that prepared me well for future research. The math bio group also benefits from interactions with the Dept. of Biology (in particular, Bill Nelson).

"In terms of the math department, I was consistently impressed by the level at which the graduate courses were taught, not simply for the course content, but for the engagement and effort put forth by the professors. I found Prof. Takahara and Prof. Mingo to be particularly effective teachers."

GRAEME GARNER, our Mathematics and Engineering Medalist this year, received the Ontario Professional Engineers Foundation of Education Medal for Academic Achievement (the highest academic standing in the final year) as well as the J.B. Stirling Gold Medal (for the highest standing throughout the four-year program). He is seen here receiving the medal from Chancellor Jim Leech, Principal Daniel Woolf and Rector Alex da Silva.

Following my graduation from Queen's, I will be joining the Autonomous Vehicle Development team at General Motors in Markham, Ontario as a Controls Development Engineer. I was introduced to controls when studying in the Mathematics and Engineering program, and became very passionate about the subject. I am thrilled to have the opportunity to begin a career in this field of study, and I find it and its applications fascinating.

For long-term goals, I am very open minded and excited to see where my career takes me. I can certainly see myself working in controls and automation for the foreseeable future, but am also very interested in aerospace engineering (particularly in space exploration) and would like to work in that industry at some point. I hope to return to school in a few years for a Master's in Engineering or Computer Science, and possibly even continue on to a PhD. I am an avid traveler, and will always be on the lookout for opportunities that allow me to work in exotic locations around the world.

Reflecting on my time at Queen's, I have nothing but good things to say. The engineering community at Queen's strikes a perfect balance between the academic and social sides of life. The Mathematics and Engineering program was certainly challenging, but it is this challenge that pushed me to focus on producing the best work I can and study hard. I hadn't even heard of the program before choosing to come to Queen's, but am very happy that I found it because I believe it was a perfect fit for my skillset.

Graeme Garner receiving the J.B. Stirling Gold Medal

POSTDOC SPOTLIGHT: JORY GRIFFIN

Jory Griffin is a Coleman Postdoctoral Fellow in the Department working with Francesco Cellarosi. This past year he was nominated for the Queen's Alumni Teaching Award. Simply getting the nomination is an honour as it requires a significant investment from a number of students. We asked Jory to tell us about himself.

"I normally describe myself as a Mathematical Physicist, but really most of the machinery I use comes from Ergodic theory. I've just finished a paper with my PhD advisor which tries to provide an answer to the question: can one derive large scale phenomena (say, electrical or thermal conductivity) of a material from the underlying microscopic quantum mechanics.

"We were specifically interested in the case where the atoms in the underlying material were arranged periodically. The idea is to write the solution to the underlying Schrödinger equation in such a way that it can be viewed as a function on some abstract mathematical space, and use the tools of ergodic theory to quantify exactly what happens when one `zooms out' from the microscopic to the macroscopic picture.

"This year I taught MTHE235 (differential equations for Electrical and Computer Engineers) and MATH112 (linear algebra). I think MTHE235 was my favourite, it was nice that everybody was on the same page and gave lots of great opportunities for coding up simulations, for example, to show the transition from undamped to overdamped oscillatory solutions. It was easy to keep everybody invested in this way

"I grew up in Newquay, Cornwall, a small coastal tourist town in the south west of the UK. I went to the University of Bristol for my undergraduate degree, and ended up staying there for my PhD which I did under the supervision of Jens Marklof. My thesis was titled 'Quantum Dynamics in Highly Localised Periodic Potentials'.

"I decided that I wanted to use the postdoc as an opportunity to move somewhere far away, so only applied to places in the US and Canada – I applied specifically to Queen's because of my previous interaction with Francesco Cellarosi, who had also previously collaborated with my PhD supervisor. I'm a big fan of Kingston (especially in the summer) – it seems to have a lot going on for a city its size.

"I decided to become a mathematician while doing my undergraduate degree. I think at first because it was the way in which I could simply prolong my stay at university. There are lots of things I like about mathematics research. First is probably the freedom, both regarding what you work on, and regarding how you do it (you can do maths anywhere it's quiet enough to think). Another big draw is the fact that every day can bring something new and interesting – I learned during many summers working in retail that this was vital to keeping me sane. Outside of mathematics – I play guitar, write and record my own music at home, and play a lot of videogames."

Francesco Cellarosi

Jory in conversation at the recent Dynamics and Number Theory conference held at Queen's.

GRADUATE STUDENT SPOTLIGHT:
STEFANIE KNEBEL

Stefanie recently received a Dean's award for Women in Science.

Stefanie Knebel completed her BSc in psychology from Laurentian University with an honours thesis that blended concepts from cognitive and social psychology. After graduating, she worked as a lab coordinator in a cognitive psychology lab at Queen's, and also as a research assistant in geriatric psychiatry at Providence Care. She then spent two years at Queen's in the undergrad math program before transferring into the MSc program working with Peter Taylor. Her research is in evolutionary game theory using methods of agent-based modeling. She has an interest in neuroscience and is hoping to incorporate that into her research. She also collaborates with ongoing work to implement basic concepts of game theory and robotics into the secondary math curriculum. In September she will begin her PhD studies at Queen's.

When asked about the highlights of her Queen's experience, Stefanie replied, "I've had the opportunity to co-publish a chapter in a book and to present at various conferences. Conferences can sometimes be hectic but I always feel a bit like a kid in a candy store! They can be quite pricey, so having a program fund and support me is great.

"I've also had the pleasure of giving a lecture to a large undergraduate class, which I enjoyed very much. The positive feedback I received from students was really encouraging. Each summer I'm involved in the SHAD program, where we do some fun math with high-achieving secondary school students. I am also a camp leader for the wonderful MathQuest camp offered by Queen's during the summer for secondary school girls. Finally, finding a community that loves board games as much I do has been rewarding in and of itself!"

When asked about her spare time, she replied: "I enjoy hiking and other physical activities, especially when outdoors. I also enjoy tinkering with robotics, such as my Arduino. Music plays a large role in my life, particularly the piano and violin. Here in Kingston, I enjoy attending the Kingston Symphony's concerts very much. I have an appreciation for antiques, especially the engineering involved, and I have an absolute love of libraries. Oh, and board games!

Siobhain Broekhoven

Stefanie with the 2017 SHAD students

Stefanie with friend

And what of her goals for the future? "I've been trying to make decisions based on what makes me happy. Following a career that includes my passions would be ideal. At the moment, learning from Peter and further exploring my interests in game theory, programming, robotics, education and research is living the dream. In the future, I hope to continue with work that provides similar challenges and fulfillment."

queensu.ca/mathstat/graduate-student-spotlight-stefanie-knebel

FAMILY MATH

As kids, **DANIEL** and **MARK TAMMING** read the same books, were taught by the same teachers, and worked the same summer jobs. Daniel closed the 'age gap' to a single year by skipping Grade 3, but Mark still headed off to university a year earlier than Daniel, choosing Apple Math for its high tech applications and the strong community. A year later, after some delicate diplomacy from Mark, Daniel entered Queen's, contemplating chemical engineering. The community spirit, the lake and the natural surroundings were major draws.

After a few months in the general first year, Daniel realized he had a theoretical bent, and his options seemed to be Apple Math and EngPhys, perhaps the latter to get some distance from Mark. But his Linear Algebra course swept him away and he signed up for Apple Math. As a bonus, he got a bargain price on Mark's freshly used textbooks, for which he paid Mark in full with shared meals from his meal plan.

The graduation date gap disappeared when Mark made a last-minute decision to go on an internship in Palo Alto with a startup that was using cloud-based machine learning to analyze satellite imagery – too many buzzwords to resist. Last September, when Mark nervously walked into the same lectures as Daniel, he was pleasantly surprised as he found that they approached problems in very similar ways. They both served on Engineering Society's Advisory Board, TA'd linear algebra, and played on the Puck & Schmucks intramural hockey team.

By now the reader may be wondering about competition. Well you can imagine how Daniel felt when Mark walked out of their Cryptography exam an hour early or how Mark felt as he clapped for Daniel's Keyser Prize-winning thesis presentation.

Looking back, Daniel sees the general first year as crucial as it buys you that time while building up your knowledge base. He loved the 4th year thesis – its slightly slower pace allows one to dive deeper and enjoy the process.

Mark's favourite bite of Apple Math is the flexibility it gives its graduating students. Employers and grad schools of all sorts value and respect the skill set that the program develops. However, there are two sides to this coin. When contrasted with the somewhat well-defined paths of other engineering disciplines, the flexibility Apple Math provides can be a bit paralyzing.

Now that the degrees are done, and the rings are on, Daniel is off to study Computer Science at Waterloo, while Mark will be joining a management consultancy in Toronto. Both hope to help design and implement leading-edge technologies, but they are finally taking different paths.

CALEB JONKER graduated this spring and was hooded by his grandfather Leo Jonker.

Caleb started out in mathematical physics, but gradually switched to pure mathematics. After his second and third years he had NSERC summer research positions, first with the SNOLAB team in Physics, and second with Jamie Mingo and Ivan Dimitrov in Math & Stats. Caleb writes:

"I have greatly enjoyed my time at Queen's, in particular the opportunities I have had doing research directly with faculty. I was really won over to pure mathematics by some of the exemplary professors in the Department. Professors Mingo and Dimitrov both played a big role in this. In this coming year I am pursuing a PhD at the University of Toronto. Though I'm sure my interests will change as time goes on, at the moment I'm thinking of working on either Symplectic or Noncommutative geometry with the aim of studying geometric models in physics. Tentatively, I hope to stay in academia afterwards, wherever that takes me. Maybe I'll end up back at Queen's at some point!"

"Grandfather" Leo was Department Head 1990-1995, retired in 2014 and was featured in the 2015 Communicator. Many years ago he also hooded Caleb's father Derek upon *his* graduation from Queen's Medical School. He has 13 grandchildren doing various things from engineering to chemistry to midwifery, but so far, he reports, Caleb is the only one studying mathematics. But the youngest is only 11, so who knows?

QGEM: APPLIED MATH STUDENT IN GOLD-MEDAL WINNING QUEEN'S TEAM

The Queen's Genetically Engineered Machine Team (QGEM) is a multidisciplinary undergraduate student team in synthetic biology. Students comprising this team study biology, biochemistry, life sciences, mathematics, engineering, and computer science. In summer 2017, QGEM worked to create a novel E. coli strain, with the capabilities to both bind to ice, and degrade hydrocarbons. This could lead to a new method of Arctic oil spill remediation. In effect, this method works to combat the limitations surrounding the current methods of oil spill remediation.

Math and Engineering student Sarah Babbitt is a member of the QGEM. She received funding from the Math and Stats Department to travel to Boston, where QGEM presented its project at the International Genetically Engineered Machine Competition (iGEM) hosted by MIT. The competition drew nearly 5,400 participants from 310 teams, representing 44 countries. Participants were provided with a kit of biological parts to work on over the summer. Extensive mathematical modelling was able to simulate the application of the E. coli strain in the environment, and ensure its practicality. The final projects were judged by a panel of industry experts. QGEM was one of only four Canadian teams to receive a highly coveted gold medal, thereby out-performing schools like MIT, Harvard, Stanford and Waterloo. Their medal was based on innovative work, mathematical modelling, human practices, and the creation of new parts.

From left to right: Sarah Babbitt, Nolan Neville, Mady Thompson and Yifei Wang.

Team leader Nolan Neville said, "Biofilms are often maligned because they are considered one of the key factors in anti-biotic resistant infections, as well as things like dental plaque. So biofilms have a bad rap. But they are also pretty useful when you can engineer them to do useful things, which is exactly what we did."

Excerpts from the Queen's Journal November 24, 2017

QMIND: QUEEN'S MACHINE INTELLIGENCE & NEUROEVOLUTION DESIGN CLUB

Cooper Midroni is entering his third year in the Mathematics and Engineering Program. He had been noticing a growing interest among students in artificial intelligence (AI), but found it difficult to access from articles and books the kind of information a Queen's Engineering student might want. Thus, last January, he founded QMIND and received a substantial turnout at the club's first information session. The club's objective is to have a lecture series, not as an additional course but as an information and resource outlet available to students interested in AI and machine learning. To keep up with new developments, the club reaches out to professionals and professors to help oversee the program as well as foster community and discussion.

Cooper In Jeffery Hall running a QMIND session.

"None of us claim to be experts in the field," Midroni said, "[we] definitely are not. What we're just trying to do is make the group as viable as possible."

Midroni's inspiration for QMIND came following his position as a marketing coordinator for the Commerce and Engineering Environmental Conference (CEEC). "As I continued to do my job I found that I was really interested in the content. I was watching less videos that were newsfeed worthy and more educational, and I had a moment where I [asked], 'is this something within a student's skill-set?'"

In the long term, Midroni hopes to see QMIND expand across the country to become "a larger force." QMIND will continue to function into the summer, expanding its email list as well as providing educational information packages and resources for continued learning.

"We're capable as students of learning and mastering any material on our own – we tend to do that throughout the year anyways," he said. "I think the best thing you can do is to understand that nothing is outside of your reach and if you can develop a community around that, then that's something really special."

ARTS AND SCIENCE GRADUATION – MATHEMATICS AND STATISTICS 2018

MATHEMATICS AND ENGINEERING GRADUATION – 2018

INAUGURAL FIELDS@QUEEN'S LECTURE SERIES

This is a new lecture series sponsored through our partnership with the Fields Institute. The inaugural lecture was given this Spring by Amie Wilkinson from the University of Chicago on *The Mathematics of Déjà vu*. There was standing room only at the lecture. At the right is Dean Barbara Crow welcoming the participants. Bottom centre is Dr. Wilkinson about to deliver her lecture.

THE CANADIAN MATH KANGAROO CONTEST

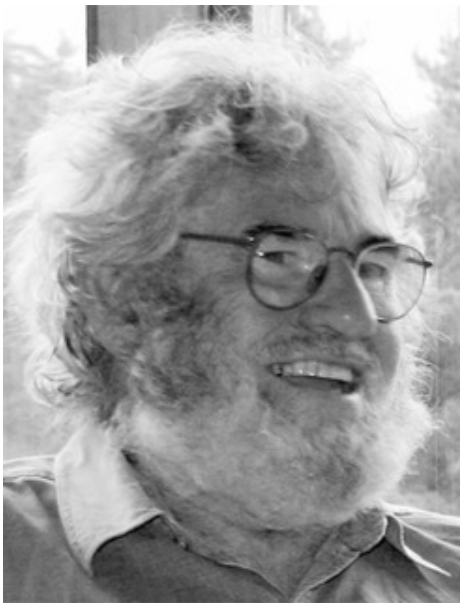
This year, for the first time, Kingston was a site for the national math kangaroo competition. The objective of the contest is to introduce students, from Grades 1 to 12, to math challenges in a fun and enjoyable way, thus inspiring their further interest and advancement in mathematics. The sessions were coordinated by Siobhain Broekhoven, the director of MathQuest, our girls math camp. At a June reception in Jeffery Hall, certificates, ribbons and medals were handed out to the top students by Jamie Mingo, Head of the Math and Stats Department. Jamie is shown in the photo along with Siobhain.

IAN HUGHES, 1934-2018

Ian Hughes was born in Johannesburg South Africa in 1934 and did his BSc and MSc at the University of the Witwatersrand. During this period he was a strong and active opponent of apartheid. He went to Oxford University to get his PhD in 1962 where his advisor was Graham Higman. He held academic positions at Liverpool, Glasgow, Natal, Witwatersrand, New York University and Penn State before taking up his position at Queen's in 1968.

Ian's early interests centred on group rings, but soon after Eddy Campbell arrived in Kingston, in 1983, Ian and Eddy began working together on modular invariant theory, a topic in the intersection of their interests. Together they proved an important conjecture of David Richman about the modular invariants of cyclic groups of prime order. This seminal result spawned an important subfield of invariant theory that continues to be extensively studied today. Indeed, within ten years, Queen's had become one of the two leading international centers for the study of modular invariant theory.

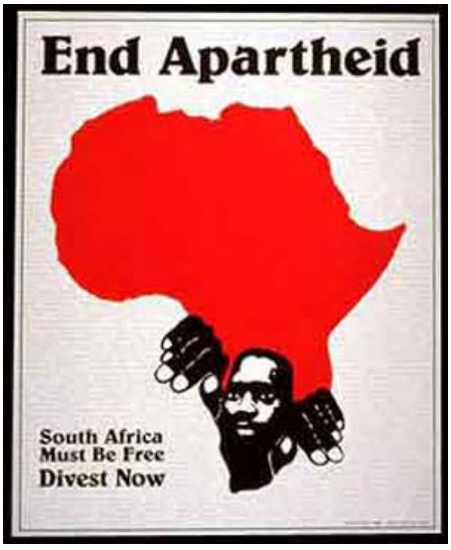
Ian spent three years during the 70s and early 80s teaching at Nairobi University. He wanted to experience life in an independent African country and he did



this with the support of the Queen's Math Department. He very much enjoyed the enthusiasm of the students there and working with his Kenyan colleagues. In Canada he participated in anti-apartheid work and together with other activists persuaded Queen's to divest from companies that had investments in South Africa.

Ian retired from teaching in 2000 but continued to be active in research and working with graduate students. During his career Ian had 27 articles published and supervised two PhD students: Rick Mollin in 1975 and Yinglin Wu in 2009. Upon the completion of Yinglin's thesis, Ian declared that that had been his last math project and put down his mathematical tools forever.

He continued to read voraciously and discuss political, social and environmental topics that interested him throughout his life. Indeed, Ian was happiest when in deep discussion, preferably while enjoying dark chocolate. Favourite subjects included politics, mathematics and soccer (he was a Liverpool fan). He was at times judgemental, but tried to treat everyone with respect and preferred being criticized to being ignored. Inquisitive, he talked to everyone, intently interested in their lives, sometimes to their discomfort. He loved connecting with people of different backgrounds and cultures, often sharing his home with them. Ian cared deeply about the earth and came to understand how intricately all life forms are connected. He hated wasteful consumerism and every capitalist plot going capitalist plot going.



Nelson Mandella 1918–2013

COVER THE SPOT AND FIND THE PHYLOGENETIC HISTORY

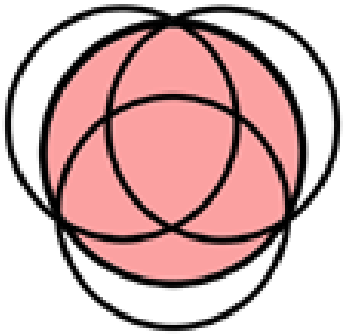
By Yuliya Nesterova

We are happy to report that Yuliya has joined the Communicator staff as Problems Editor. Yuliya was a Queen's undergraduate and active member of the department organizing DSC events, notably the PiDay jeopardy competitions, and for many years leading innovative sessions in MathQuest. She was written up in the 2017 Communicator for her participation in the NSERC Action Video Competition. In each issue, Yuliya will discuss an interesting problem.

I'd like to bring to your attention a carnival puzzle: Cover the Spot.

Ask a friend for 5 toonies and place them, overlapping, over the red spot so that no red is left showing. The benefit to using friends' toonies is, of course, that if you are sufficiently clever to impress them, they might well let you keep the toonies, and that's $10 right there. The next question, for the impressed friend especially, is to ask if toonies are strictly necessary, and if a loonie would do: in general, how small a denomination of coin and of radius could we have gotten away with so as to not lose money on our clever friends. And that is how one lapses into circle-covering research.

In fact, just such questions were asked and answered by Károly Bezdek and Gábor Fejes Tóth around 35 years ago. In the interests of bets being placed and puzzles conquered, I won't reveal the solution: find it at www2.stetson.edu/~efriedma/circovcir/



Yuliya in green at MathQuest 2017

The arrangement for 3 circles you see here, along with a promise that our puzzle is not so simple, or else it wouldn't be confounding and discombobulating people at carnivals for years past and years to come. I promise that in this case, no scam or rigging will work against you; the puzzle exploits only our propensity to expect symmetry from our circles.

If you're trying to make all the toonies touch the center, it's the five-disks-problem you are solving and it won't do the trick. The 5-disks-problem asks: what's the smallest radius r for which 5 disks of radius r, placed symmetrically about a spot's center, cover a spot of radius 1? See more at mathworld.wolfram.com/FiveDisksProblem.html, but it won't do for cracking the puzzle above: our spot is *just* big enough that this arrangement will leave red peeking through. A toonie has a diameter of 28mm; the circle here: 45.8mm. That ratio is close-to-but-not-quite-the-limiting case and I encourage you to find the limiting case, and to prove it. A larger construction would show that there's a fine line between ratios that allow a symmetric solution and ones that don't, and the golden ratio makes a brief but somewhat unhelpful appearance. A 1915 paper by E.H. Neville: "On the Solution of Numerical Functional Equations: Illustrated by an Account of a Popular Puzzle and of its Solution" will guide you to the optimal case.

Such puzzles have a way of finding applications. Cell towers' coverage over an area can be modeled as coins covering spots: and the spots don't have to be circular! If we minimize the area of overlap between coins, we arrive at an application in printing out images, converting continuous spectra to pixels in a page (2008 paper on digital halftoning by T. Asano, P. Brass, S. Sasahara). But there are more exotic applications, particularly apt in 2018 (this being the year of mathematical biology): "Disc Covering Methods improve phylogenetic analyses", in a paper by M.S. Bayzid, T. Hun, and T. Warnow. DCMs, as they are abbreviated, shorten computation time when reconstructing trees that model the evolution of multiple species. Split the dataset into subsets with minimal intersection (our "coins"): run your algorithm on each subset, "rinse, repeat". Who would've thought our simple puzzle could evolve to have so many uses? But have you solved it yet?

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