Issue Contents

Termeh Kousha (Canadian Mathematical Society)

Executive Director

I go back to my cover article from Dec. 2019 for inspiration and as I read those lines and think about writing them, I realise that we have been living in pandemic life for 8 months now. During the past 8 months, life, on personal and professional levels, has been anything but normal. CMS Notes articles of the past few issues is a testament to our struggles to find ways to readjust our lives to the new normal, they are also writ with a mixture of uncertainty and hope. Uncertainty about the future and the duration of extraordinary measures; and hope that some of these changes can open new horizons and transform the balance of our lives. The CMS staff and volunteers have not been exempt from these changes and sentiments. Many of us have had to find a way to care for younger or older members of the family, grapple with anxieties associated with a change in income or the possibility of it lingering in the air, especially for the more precarious among us and a myriad other uncertainties. The pandemic has displayed our resilience but has also exposed the gaps and inequalities in the community that we should aspire to eliminate (article by women in mathematics).

The CMS started the year 2020 with great news from NSERC and RBC Foundation regarding funding towards CMS educational programs. With the new grants, the CMS had enough funding to organize more specialty camps and activities especially for Indigenous students and Northern communities. Moreover, the CMS was able to offer more funding for competitions across Canada. We were also preparing ourselves to celebrate CMS 75th anniversary in Ottawa with over 45 sessions with over 700 participants from all over the world. In short, we were all ready to start a year full of success and new initiatives. Like many other organizations, the pandemic affected many of our plans in the CMS.

The pandemic also presented us with a chance to show creativity and resilience and I dare say the CMS staff and volunteers came out of this challenge victorious. As it is tradition here at the CMS Notes, I will present an account of programs developed and conducted and an overall focus of the Society in the paragraphs that follow.

In 2020, the Society has continued its efforts to make mathematics more equitable and open to new perspective and new epistemological frames of reference.

New funding from RBC Foundations' Future Launch program allowed the Society to add new specialty camps to its math camp program and launch its inclusion initiative: "Closing the Gap". There were plans in place for new additional math camps in the Yukon, including two rural camps in Indigenous communities and an additional camp in Whitehorse. Unfortunately, rural camps in the Yukon were canceled due to COVID-19 restrictions, but the funding was spent on expanding Whitehorse camps from two to four in order to create more social distancing and be able to organise the camps in compliance with public health protocols. Another new special camp this year was a math camp for students on the spectrum in Toronto. Fortunately, despite the difficulties, organisers worked hard to create this space for students who had been deprived of school and social life because of COVID-19 restrictions. The CMS' very own Dorette Pronk, who has worked hard for years for girls in mathematics, along with Diana Castañeda Santos organised a virtual all-girl math camps for EGMO and IMO hopefuls for the first time in the history of the CMS. We are planning to hold an all-girl in person camp for hopefuls once life is back to normal. Many of our other specialty and regional camps were canceled because of the sudden nature of the changes and lack of time and resources to properly plan a virtual alternative. However, the turn towards virtual has now equipped us with the tools and the aptitude to transition smoothly should other obstacles present themselves in the coming years.

Terms of Reference

One of the most important achievements of the CMS in 2020, the result of months of hard work and with the help of the chairs of the CMS committees and the staff, was updating the CMS Terms of Reference, which have not been modified for more than a decade. I dare say this was my biggest achievement since the start of my mandate at the CMS. The updated Terms of Reference are now available on our brand new website, yet another CMS achievement in 2020. The Terms of Reference are also being translated for the first time to French.

> *The pandemic also presented us with a chance to show creativity and resilience and I dare say the CMS staff and volunteers came out of this challenge victorious.*

🐦 Tweet

Math Camps

In 2020, the Society has continued its efforts to make mathematics more equitable and open to new perspective and new epistemological frames of reference. New funding from RBC Foundations' Future Launch program allowed the Society to add new specialty camps to its math camp program and launch its inclusion initiative: "Closing the Gap". There were plans in place for new additional math camps in the Yukon, including two rural camps in Indigenous communities and an additional camp in Whitehorse. Unfortunately, rural camps in the Yukon were canceled due to COVID-19 restrictions, but the funding was spent on expanding Whitehorse camps from two to four in order to create more social distancing and be able to organise the camps in compliance with public health protocols. Another new special camp this year was a math camp for students on the spectrum in Toronto. Fortunately, despite the difficulties, organisers worked hard to create this space for students who had been deprived of school and social life because of COVID-19 restrictions. The CMS' very own Dorette Pronk, who has worked hard for years for girls in mathematics, along with Diana Castañeda Santos organised a virtual all-girl math camps for EGMO and IMO hopefuls for the first time in the history of the CMS. We are planning to hold an all-girl in person camp for hopefuls once life is back to normal. Many of our other specialty and regional camps were canceled because of the sudden nature of the changes and lack of time and resources to properly plan a virtual alternative. However, the turn towards virtual has now equipped us with the tools and the aptitude to transition smoothly should other obstacles present themselves in the coming years.

Competitions

Following the school closures, which were brought upon by the lockdown, the CMS saw a demand to keep students' math skills sharp during the pandemic. We sought resources and presented them to a great number of school districts across the country, created new social media pages to cater to students, their caregivers and their math educators. The CMS also created a brand new competition, the Canadian Mathematical Gray Jay Competition, for primary students. The new competition, which was also offered in virtual format this year, consists of multiple-choice questions and its objective is to engage younger students with mathematics, in a fun and stimulating way. The Canadian Open Mathematics Challenge (COMC) too had to be offered in two formats, paper and virtual, to meet the needs of all participants this year. This added to the complexities of organising the competition but the CMS staff and competition committee were happy to continue to foster mathematics interest among the youth.

This year, as part of CMS' "Closing the Gap" initiative, the CMS sought to increase participation of Black and Indigenous students in its activities and sponsored their participation in the Gray Jay and COMC. Black and Indigenous students who participate in the competition also run the chance to win 500 dollars for their classroom. To better prepare students for the competition, the Society also organised a series of webinars focused on Indigenous epistemologies, unconscious biases and competition prep. The webinars were great success and we hope to expand on them and create more opportunities for mathematics educators and students to tackle equity issues in the community.

The CMS has never been prouder of its young Olympians who showed that no challenge is too great for them. Girls' Math Team Canada participating at the European Girls' Mathematical Olympiad had to change its plans within a short delay to write the competition virtually. A disappointing news which meant that they will be deprived of an important aspect of the Olympiad, the gathering of young women mathematicians and their mentors. Despite the challenges and uncertainties, they managed to win one silver medal, one bronze medal and an Honourable mention.

Math Team Canada participating at the International Mathematical Olympiad too had to switch to virtual and could not make the trip to Saint Petersburg, Russia. Furthermore, the competition was postponed to September in the middle of the school year and training had also have to be moved online. But the team had one of its best performances in the history of Canada's participation in the IMO. The team members, who wrote the competition in Toronto, won three gold medals, one silver and two bronze medals.

The CMS is also grateful for the hard work and dedication of team leaders, trainers, proctors and everyone involved in the EGMO and the IMO.

> The CMS has never been prouder of its young Olympians who showed that no challenge is too great for them.

Meetings/Zoomings

CMS staff, participants and the organising committee were disappointed by the cancelation of the CMS 75th anniversary summer meeting. This did not, however, discourage these hardworking people, they are making sure the CMS 75th+1 anniversary Summer Meeting could be a meeting to remember. The focus then went into finding a way to address the concerns and anxieties of educators who had to change their teaching style and accept the caprices of online teaching. In the course of a few short and busy weeks, CMS staff and volunteers managed to organise a virtual meeting, a first for the CMS, to discuss research and education during the pandemic. The participation and discussions surpassed our expectations and some sessions will continue in the 2020 virtual Winter Meeting. The CMS also held sessions on K-12 math education and hopes to continue the relationship with K-12 teachers and organise more events focused on math education for younger students. Indeed, the enthusiastic participation and discussions that took place during the meeting was an antidote to our disappointment and demoralisation following the summer meeting cancelation. Despite the hard times, we saw the possibilities for creativity and new horizons ahead of us for the years to come. We are excited to continue the stimulating discussions during the Winter Meeting, albeit virtually, and are hoping to gather again in better times.

Workshops for the public service employees

In the collaboration with University of Ottawa, CMS was abled to run the first set of online workshops for the government employees. The first of these workshops were held virtually in October and was a great success. Some 30 public employers participated in the first round of these workshops and around the same number is expected for the second workshops in December 2020.

Survival of the CMS

While everyone at the Society has been working hard to implement new initiatives to help the mathematical community fare the hard times, Summer meeting cancelation, the change in format for Winter Meeting and the impact of COVID-19 on the competitions, and that of the open access on publications, they have all had serious financial impacts on the Society. The CMS is seeking new ways to regain its financial stability. Here is how you can help:

House of Mathematics

After much elaboration and calculation, the CMS board members came to the conclusion that the soundest financial decision in the moment we are experiencing would be for the CMS to own its own residence, the House of Mathematics. Such a House would not only improve the financial situation of the CMS, but it will also be a place for the Canadian mathematical community. The Society is urging members to generously contribute to this project and help the CMS find a permanent residence.

Canadian mathematical community. The Society is urging members to generously contribute to this project and help the CMS find a permanent residence.

New Sponsors for CMS Competition

The CMS is currently seeking sponsors for its mathematical competitions for high school and elementary school students, the Canadian Open Mathematics Challenge and the Canadian Mathematical Gray Jay Competition. The Society encourages the members to let the CMS staff know of sponsorship opportunities within their networks.

Looking Ahead

Whether a vaccine can be envisaged for the next few months is not a certainty. What, however, is certain, especially in the view of the current crisis, is that mathematics is important and touches many aspects of our everyday lives. Numerous interviews with epidemiologists, mathematical biologists, the parade of graphs predicting and explaining COVID trends, and the impact of mathematics in both public health and economic policies, they all attest to the role mathematics plays in our personal and social life. The CMS will continue to work tirelessly for the community in the year ahead.

With the help of our staff, our volunteers and our members, we will form closer relations with communities whose epistemology and perspective have been invisibilised in the community and seek to make the Society a dynamic and open venue for teaching, research, and learning in 2021

On a more personal level, this year my husband and I celebrated the birth of our first child, Farid Kian, who brought lots of joy, hope and love into our life. During my absence, Yvette Roberts is taking care of the executive office. I am looking forward to be back in the office next Fall. I would like to thank all the CMS staff for their hard work, dedication and help during my leave.

This Year's Conference

Robert Dawson (Saint-Mary's University)

Editor-in-Chief

In my first year as an undergraduate student, they told me about a math contest at UPEI, connected with some conference. A vanload of students and faculty left Dal at daybreak and arrived at UPEI mid-day: then I and the other students wrote the contest paper (still a feature after forty-some years!) After that, I heard my first math conference talks… and acquired a lifelong taste for them. Three years later I presented a paper there myself. Given that conference's formative effect on me, I was very glad that we were able to put its successor on this year despite the COVID-19 restrictions. October just wouldn't have been the same without it.

We managed to arrange a reasonable version of that math contest, the programming contest, the business meetings, and the three plenary talks (one in each of mathematics, statistics, and computer science.) Though the pandemic had reduced the number of students doing summer research projects, we still had about twenty undergraduate presentations – for the most part, stunningly professional – and half a dozen talks by graduate students. One plenary talk, and a couple of student talks, were actually about the pandemic; but we also had the usual talks about algebra, AI, astrophysics, and everything in between. (And once again apprentice graph theorists were developing their chops on cops-and-robbers games – as much a local tradition as fiddling, fishing, and fog.) Normality reasserted itself, in the middle of a very strange year.

It was a pleasant surprise to see how easy it was to organize. There were no hotel bookings, airfares, catering fees, or room fees to arrange. Our budget was well under a thousand dollars, and we didn't spend all of that: our Zoom accounts worked perfectly, so the small fund for emergency replacement of non-functional software was untouched. (We hadn't had any reason to suppose we'd need it, but it made us sleep better in the days leading up to the event.) With so few expenses, there was no fundraising, no conference fees to collect, no accounts to set up, and no financial paperwork – even with a hundred and fifty people attending.

We did not manage any social events: it would have been nice to have software that would have let us gather into small groups at (self-catered) "coffee breaks" and chat, moving freely from group to group. No doubt such software exists (somebody joked about repurposing a massively multiplayer video game) but we were pushing our

collective envelope as it was. That was the only big thing missing.

An outsider might think the invited and contributed papers, and maybe an odd business meeting, would be all that's really important at a conference. In fact, why not just read the papers on arXiv when you've got some free time? Yeah, sure: and a human being consists of sixty-five percent oxygen, eighteen percent carbon, ten percent hydrogen, and a smear of this and that. The fact is, those chats over coffee, longer conversations over meals, and the opportunity to live for a few days in a world totally centered on mathematics are important too. When things get back to normal (and they will) I don't expect Zoom meetings to go away – they are so convenient. But they may well be seen more as expanded seminars than as diminished conferences.
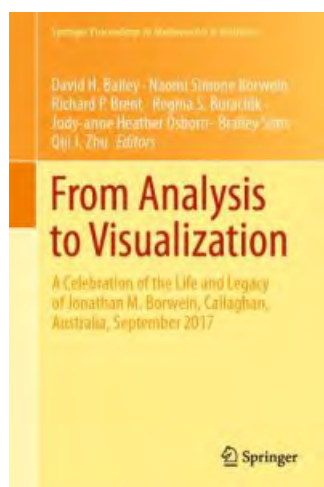
We shall see.

Karl Dilcher

Book Review Editor

Book Reviews bring interesting mathematical sciences and education publications drawn from across the entire spectrum of mathematics to the attention of the CMS readership. Comments, suggestions, and submissions are welcome.

Karl Dilcher, *Dalhousie University (notes-reviews@cms.math.ca)*

From Analysis to Visualization

A Celebration of the Life and Legacy of Jonathan M. Borwein

Edited by David H. Bailey et al.

Springer, 2020

ISBN: 978-3-030-36567-7

Reviewed by Karl Dilcher

The late Jon Borwein (1951-2016) spent most of his career in Canada (at Dalhousie, Waterloo, and SFU), during which time he was a strong force in research, education, publishing, and matters of policy and administration. He served for the CMS in numerous capacities, including a term as president from 2000 to 2002; several tributes can be found in the December, 2016, issue of the CMS Notes.

Jon spent the last part of his career at the University of Newcastle in Australia, and quickly became as influential in Australian mathematics as he had been in Canadian mathematics. The volume under review contains the proceedings of a conference in Jon's memory that took place in September, 2017, in Newcastle, NSW. In the interest of full disclosure I must mention that I participated in this event and have a paper published in this volume.

The book begins with a detailed preface, the contents of which are best summarized by its section headings: Jonathan Borwein: Mathematician Extraordinaire; A Portrait of the Man as a Mathematician; Nonlinear Analysis and Optimization; Experimental Mathematics; Number Theory, Special Functions and Pi; Mathematical Finance; Mathematical Education and Public Communication; Visualization; and Summary.

The research papers in this collection are then organized in four parts, each with an introduction by the relevant edtiors. Part I: *Applied Analysis, Optimisation, and Convexity*, edited by Regina S. Burachik and Guoyin Li, contains the following papers: "Symmetry and the Monotonicity of Certain Riemann Sums," by David Borwein, Jonathan M. Borwein and Brailey Sims; "Risk and Utility in the Duality Framework of Convex Analysis," by R. Tyrrell Rockafellar; "Characterizations of Robust and Stable Duality for Linearly Perturbed Uncertain Optimization Problems," by Nguyen Dinh, Miguel A. Goberna, Marco A. López and Michel Volle; "Comparing Averaged Relaxed Cutters and Projection Methods: Theory and Examples," by Reinier Díaz Millán, Scott B. Lindstrom and Vera Roshchina.

Part II: *Education* was edited by Naomi Borwein, and contains "On the Educational Legacies of Jonathan M. Borwein," by Naomi Borwein and Judy-anne Osborn; "How Mathematicians Learned to Stop Worrying and Love the Computer," by Keith Devlin; "Crossing Boundaries: Fostering Collaboration Between Mathematics Educators and Mathematicians in Initial Teacher Education Programmes," by Merrilyn Goos; "Mathematics Education in the Computational Age: Challenges and Opportunities," by Kathryn Holmes; "Mathematics Education for Indigenous Students in Preparation for Engineering and Information Technologies," by Collin Phillips and Fu Ken Ly; "Origami as a Teaching Tool for Indigenous Mathematics Education," by Michael Assis and Michael Donovan; "Dynamic Visual Models: Ancient Ideas and New Technologies," by Damir Jungić and Veselin Jungić; "A Random Walk Through Experimental Mathematics," by Eunice Y. S. Chan and Robert M. Corless.

Part III: *Financial Mathematics* was edited by David H. Bailey and Qiji J. Zhu, and contains the following papers: "A Holistic Approach to Empirical Analysis: The Insignificance of P Hypothesis Testing and Statistical Significance," by Morris Altman; "Do Financial Gurus Produce Reliable Forecasts," by David H. Bailey, Jonathan M. Borwein, Amir Salehipour and Marcos López de Prado; "Entropy Maximization in Finance," by Jonathan M. Borwein and Qiji J. Zhu.

Part IV: *Number Theory, Special Functions, and Pi*, edited by Richard P. Brent, contains the following papers: "Binary Constant-Length Substitutions and Mahler Measures of Borwein Polynomials," by Michael Baake, Michael Coons and Neil Mañibo; "The Borwein Brothers, Pi and the AGM," by Richard P. Brent; "The Road to Quantum Computational Supremacy," by Cristian S. Calude and Elena Calude; "Nonlinear Identities for Bernoulli and Euler Polynomials," by Karl Dilcher; "Metrical Theory for Small Linear Forms and Applications to Interference Alignment," by Mumtaz Hussain, Seyyed Hassan Mahboubi and Abolfazl Seyed Motahari; "Improved Bounds on Brun's Constant," by Dave Platt and Tim Trudgian; "Extending the PSLQ Algorithm to Algebraic Integer Relations," by Matthew P. Skerritt and Paul Vrbik; "Short Walk Adventures," by Armin Straub and Wadim Zudilin.

This sizeable volume is a fitting tribute to the legacy of Jonathan Borwein, who made enormous and lasting contributions to so many different areas of mathematics and of learning.

Kseniya Garaschuk, Vanessa Radzimski

Many universities have already announced their plans for the winter term: the vast majority of higher education institutions will offer courses in a remote environment in the winter 2021 term. While we may continue to lament over the numerous disadvantages of online teaching and learning, we must accept that it is our reality for at least one more term. As such, we owe it to our students and our colleagues to make the best of the situation, to be flexible and open-minded in the new environment, to learn previously unfamiliar tools and technologies, to reflect on our practice and to adjust.

Fall term is in full swing and by now we've all had our fair share of remote teaching experiences. Everyone seems to have invented their own recipe for synchronous and asynchronous pedagogy, but we can all agree on the following: synchronous online sessions are decisively not the same as synchronous face-to-face lectures and cannot be treated as such. Below we present to you a collective wisdom, compiled into 10 P's. While the suggestions are general to online teaching, we have developed these suggestions with mathematics teaching in mind.

Ten Practical Principles of Prosperous Pandemic (remote) Pedagogy

- **Plan, plan, plan...then plan some more**
  Ad-hoc teaching is a no go. Go into class with a solid lesson plan and rigorous schedule for how time will be spent. For breakout rooms: provide a specific task or deliverable, preferably in advance of the class. Plan for flexibility to accommodate technical issues and life.

- **Practice**
  Try out the breakout rooms, screen sharing, test the links, test your equipment, if possible test different browsers and computer systems. Make sure you are comfortable with what students will be experiencing before you put them through it.

- **Pre-record**
  If you plan to talk for more than 20 minutes, consider pre-recording. This way, students can engage with the material at their own leisure. Furthermore, the synchronous delivery of important content can be interrupted by technical issues, resulting in a frustrating scenario for yourself and your students.

- **Prepare**
  Your personal workspace is your classroom in the online teaching environment. Prepare and test your equipment and links you will use well before students arrive. Have a back-up plan in case of technical issues. Inform students of online classroom etiquette you want them to adhere to (mute, raise hand to speak, put questions in the chat, use headphones, etc)

- **Participate**
  Get students involved: chat, screen annotation, voting questions, non-verbal feedback (reactions, thumbs up/down), breakout rooms, … It is best practice to move content delivery to asynchronous domain.

- **Poll progress**
  Check whether the students follow. You can use the poll feature built into your video conferencing software or an alternative software such as Kahoot or Socrative (both of which are free and do not require students to login).

- **Pause**
  Do not talk for long, take frequent breaks to allow for questions (play Jeopardy music in the background if the silence is too much for you), tell students how they can ask (chat, voice, raise your hand)

- **Place**
  Create places and spaces for the students to collaborate outside of the video call. Without physical proximity and ability to see each other's notepads, students need a space to share work and discuss it. Consider external places of collaboration, such as Padlet, Google Docs/Sheets/Jamboard, AWW.

- **Presence**

Create opportunities for students to share about themselves to build class community with their presence. Include getting-to-know-you activities, make introductions a part of each breakout room activity, ask students to upload profile pictures (not necessarily of themselves), play music while students arrive (ask for preferred genres), start class off with a brainteaser. While everything in online pedagogy tends to be intentional, it does not need to be impersonal

○ **Possibilities**
With everyone connecting through a device, there are endless possibilities to not just talk (let's be honest: your face isn't that exciting). Use visuals, use graphing tools, use websites, etc. Recognize that there is potential beyond lecturing in an online learning environment.

Laurestine Bradford, Yuveshen Mooroogen

Introduction

In the middle of the 2019-2020 school year, the COVID-19 pandemic hit Canada. By the end of March, most schools and universities had shut down in-person classes. Ongoing courses had to be transformed for online delivery almost overnight, and new courses that were starting in the spring were being taught online by instructors with little to no experience with this medium.

In light of this, it should come as no surprise that most of the discussions at the CMS COVID-19 Research and Education Meeting (CCREM), held between July 13th and 16th, focused on issues of remote teaching.

One of the sessions at this event was organized by Peter Taylor, and titled *When a Door Closes ... The Creative Fallout of the Pandemic.* The goal of this session was to discuss the changes made due to the pandemic that we would like to keep and develop as we move forward.

The speakers at this session included university instructors from multiple provinces who had gone through the unexpected transition to online teaching, university instructors with no online teaching experience, and, of course, the authors of this article: a Master's student who taught outreach online and an undergraduate student who was taking a remote course at the time.

In what follows, we present a snapshot of some of the discussions we had with our fellow speakers following this session. We hope this will serve as a time capsule recording some thoughts that we had prior to jumping into the new school year. What changed since then? Have our priorities shifted? How have our views on remote education changed with experience?

What we value in times of chaos

This pandemic is overwhelming. In addition to the stress it adds to everyday life, it forces us to collectively learn to employ technologies that many of us never (or rarely) have touched before 2020. The array of available technologies is bewildering, so we wanted to focus on keeping things simple for ourselves and our students. Below, we describe some of the priorities session presenters focused on preserving, and strategies they used to do so.

Mathematics

Of course, the priority in a mathematics classroom is to teach mathematics. We must not lose sight of that.

Community

How do we turn an online classroom into a learning community? In order for students to feel connected to each other, they must *do* something together. For this reason, group work is vital to give students a chance to collaborate with each other in the virtual "room". We discussed the merits of assigning the students to groups (it saves organizational time, students meet more people, they hear more diverse perspectives, and no one gets excluded) and of letting students choose their own groups (students feel more in control, can self-select whether to talk to others, and can form and reinforce connections with people they know they like). Allowing students to tackle components of a course that might be more stressful (such as presentations) together can further reinforce an atmosphere of mutual support.

The pandemic also exacerbates the importance of support systems for students outside the classroom, such as teaching assistants, student unions, counselling, and peer study groups. In addition, technologies that allow students to reach out directly to each other, such as the private chat function in a videoconference software, can also help the school environment feel more human.

In thinking about the kind of community we create for our students, we are also led to consider our own roles. Teachers set the tone for the class through their level of organization, flexibility, and approachability. Many teachers have a well-established persona, a face they feel comfortable presenting to their classes, and while this persona may work well in their usual classroom environment, the unfamiliar online setting can quickly throw it off. The gestures we are used to making do not come across over a webcam, the back-and-forth exchanges we are used to having with our students can all too easily become clunky and artificial, and our familiar toolkits of blackboards and chalk have been replaced with windows and keyboards. Many teachers must therefore revise the persona they present, which creates an uncertainty that can make us feel vulnerable. However, as Laurestine Bradford pointed out in her presentation [1], this vulnerability can be an asset, as it can make us more approachable and less intimidating, so that our discomfort can aid our students' comfort.

In the new medium, there are various means of engaging students in conversation in ways that we could not before. Margaret-Ellen Messinger and Andrijana Burazin, in their presentations [7, 2], described various benefits to both polling and chat functions in videoconferencing tools: students help each other out, you get a window into student thinking, and you get input from students who would ordinarily be quieter. How can we then import those functions into an in-person class?

Assessment

Despite the pandemic, we are required to evaluate students and give them grades. Without proctored exams, traditional testing is next to meaningless, and we are compelled to seek innovative assessment structures. Here are some ideas presented at the session:

- Designing test questions that require critically evaluating a problem or data, explaining reasoning, and synthesizing information in new ways. Of course, we must first teach these skills, before testing students on them.
- Including more presentations and long assignments in the course marking scheme.
- Replacing exams with a final project.

When it comes to incorporating student projects in a class, the pandemic has a specific silver lining, which we describe in the next section.

COVID-19 as an object of study

With regard to student projects centred on mathematical modelling, presenter France Caron noted that "the more relevant the topic, the greater the interest in capturing its complexity." [2] In this respect, the coronavirus presents a unique opportunity: we now have a topic that is highly relevant to all of our students. Indeed, we are seeing almost unprecedented popular interest in mathematical models, as we all scramble for mathematics to tell us how socially distant to be, whether it's okay to ride public transit, where to wear masks, when to wash them, and more. This opens the door to high student engagement in projects modelling COVID-19, which can touch on differential equations, agent-based simulation, probability, and numerous other mathematical concepts. It is a golden opportunity to show our students how and why math can be important to them.

But this opportunity will not last forever. As time goes on, students will grow tired of hearing about the pandemic, and these projects may lose their appeal. In what other ways can we make our classes relevant to our students' lives? Kseniya Garaschuk [6] talked about implementing more "just-in-time" teaching in her courses, by committing to include current events (pandemic related or not) as a way of making the course situated in time and space. Any topic the student personally cares about will provide ideal motivation for a modelling project.

As an aside: the authors of this report were used to developing activities whose value was "intrinsic" – which had a beautiful mathematical structure regardless of any real-world context. As such, we viewed COVID-19-based projects as anomalous, in that the extrinsic motivation was so massive as to eliminate the need for intrinsic interest. One of the presenters explained to us that in a modelling context, it is almost meaningless to distinguish intrinsic from extrinsic motivation. The goal of any modelling project is precisely the connection between the mathematics and application, and this connection to context must drive everything the modeler (or student) does. And, indeed, the fit of a well-made model has its own inherent beauty that is just as lovely as a beautiful theoretical problem.

In an ideal modelling project, the teacher will take something students already find important, and encourage them to use math to say something meaningful about it. They must also leave students enough space to make the project truly their own. However, students' personal goals and aspirations are as diverse as our students themselves. So, our big question about student modelling projects is: *How do you help students find something they care about, and find the math in it?*

Another approach to motivating mathematics through modelling projects is to embed the models in a larger story that is told over an extended period of time. Kseniya Garaschuk showed an example of such a story she described in [5]: mathematical tools get developed along with the story, and complexity of mathematical analysis is required by the increasing complexity of the questions that arise in a genuine context.

Storytelling in the time of COVID-19

Even outside of modelling projects, the presentation of course material can always benefit from good storytelling, which involves a clear overall structure, motivated transitions, and a point. This is more important now than ever. One presenter, Ed Doolittle [4], explained how having to stay indoors during the pandemic is similar to an Indigenous experience of winter – and winter, in this worldview, is a time to sit together and share stories.

That said, the distance between teachers and students offers special impediments to storytelling. Most notably, we can no longer see the people we are speaking to. Many teachers are used to watching certain particularly expressive students to gauge the audience, a technique which is now next to impossible. We also lose access to the underappreciated wealth of information that we gather from our less expressive students in the form of shuffling papers, whispers to neighbours, and glances at phones.

So, to tell stories these days, we must turn to modes of communication that do not rely on physical proximity to students. Such modes do exist; ever since the invention of cinema, people have been developing ways to tell good stories through pre-recorded videos, and in some cases have met with great success.

Fortunately, if we do not have time to become expert filmmakers, there are simpler ways of telling good stories at a long distance. Yuveshen Mooroogen described, in his presentation [8], his experience with taking a course via telephone, and how the "gossipy" flavour of the medium put him on equal footing with his instructor, allowing him to steer the conversation and the course towards areas he found interesting. Of course, this method does not generalize to arbitrarily large classes. We also find long-distance storytelling in books. If there is a textbook that does well at situating material in a good story, then the teacher can partly relinquish the storytelling duty, and spend valuable virtual class time in other ways, such as clarifying specific exercises.

In reality, the storytelling medium we choose is subordinate to the kind of story we want to tell. We mean this in two senses. First, the medium we should choose depends on what we want to say. Second, the choice of medium, whatever it is, is far less important than knowing what we want to say. When a class has a clear story and message, this can usually survive even awkward long-distance technologies; conversely, when a class does not have a clear story, it is easily derailed during this distracting time of pandemic. We come in this way to the following question: *What kinds of stories should we be telling our students?*

Conclusion

We hope that this snapshot of our CCREM experience will help the reader reflect on what they have learned from the past few months. As the fall draws to an end, we brace ourselves for the winter, armed with courage and imagination, but this time also with experience.

Acknowledgements

The authors of this article would like to thank Peter Taylor for inviting us to speak at the CCREM. We are also grateful to Kseniya Garaschuk for her help in putting this piece together. Finally, we would like to thank our fellow speakers for taking the time to answer our questions and for sharing their insights with us.

Laurestine (Lola) Bradford is a master's student in the Department of Linguistics at the University of Toronto, where she also completed a bachelor's degree in Mathematics and Philosophy. Lola has long been involved in math outreach and education. She hopes to study what ideas from language acquisition can tell us about how people learn mathematics.

Yuveshen (Yuve) Mooroogen is an undergraduate student at the University of Toronto. Ever since a particularly charismatic first-year course in analysis, he has been pursuing a degree in mathematics. Currently, he is interested in functional analysis and math education. Yuve believes that a compelling narrative is the backbone of any good learning experience.

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Amy Ackerberg-Hastings (*MAA Convergence*)

For historians, the phrase in the title is not so much about the philosophical possibility that some theorems or fields might pass away as about a category of primary source that was designed to be temporary. Types of ephemera include advertisements, posters, pamphlets, speeches, cards, instruction manuals, event tickets and programs, calendars, and paper games or toys. While it is natural to think first of monographs, journal articles, textbooks, and correspondence when one is looking for historical documentation of mathematical developments — and maybe second to consult objects such as mathematical instruments, which have previously been discussed in the "CSHPM Notes" column [1; 3] — ephemera can also provide insights into the past of mathematics, perhaps particularly with respect to its culture, professional practice, and educational history. Additionally, ephemera are typically colorful and inviting, making them an appealing addition to classroom teaching.

Ephemera are often a blend of text, image, and object, so historians similarly use a blend of techniques for analyzing them as primary-source evidence. First, of course, they try to determine who made the item, when, where, for whom, and for what purpose. Then they visually "read" any drawings or photographs, taking note of each component of an image — who are the people? where were they? what other elements are used to communicate a message? — in order to deduce what the creators intended the illustrations to convey and what readers thought the pictures meant. Historians further seek to put these items into historical context by comparing them to other ephemera as well as to other forms of primary sources.
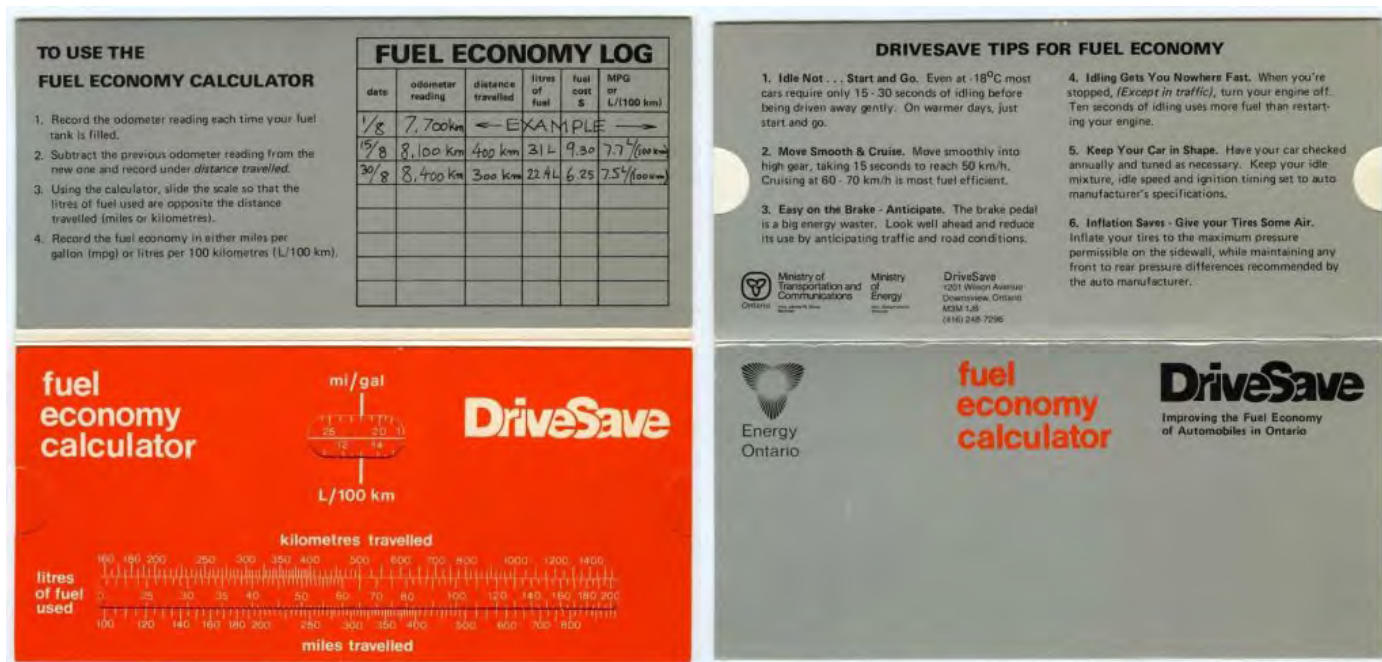

Figure 1. DriveSave Fuel Economy Calculator (unfolded), Ontario Ministry of Transportation, 1982. National Museum of American History (NMAH), Smithsonian Institution, neg. nos. AHB2009q09107 and AHB2009q09108.

For instance, this paper slide rule was issued in 1982 by DriveSave, a joint initiative of Ontario's Ministry of Transportation and Communication and Ministry of Energy that promoted fuel economy from 1981 to about 1994. Consumers were supposed to adjust the lower scale until the number of litres of fuel used lined up with the distance traveled. They were then to read the fuel economy from the upper scale and write the result on the provided log. Helpful tips for increasing the efficiency of one's automobile appeared on the back of the rule. Although a similar calculator was distributed to truck drivers, this promotional item was produced for only two years [4,

1982, p. 141, 1983, p. 194, 1984, pp. 169–170]. The mathematics may not be very interesting, since the slide rule is based on a simple linear relationship, but this bit of ephemera tells us something about government outreach efforts as well as assumptions about popular numeracy.

The Fuel Economy Calculator happens to be one of the slide rules I catalogued at the Smithsonian's National Museum of American History several years ago, but historical mathematical ephemera may be found outside of museums. The authors of books and articles on the history of mathematics sometimes use ephemera as illustrations. Depending on how often readers clean their own offices, old conference programs or examination papers may already be lying around. When it is possible to return to departments, check file cabinets for flyers from previous events or materials prepared in support of program or university initiatives. Similarly, institutional libraries and archives sometimes collect and preserve ephemera. It is never too late to start a collection of memorabilia, promotional items, or advertisements that make references to mathematics. And, like most other things, ephemera may turn up on the internet.

Figure 2. Meeting program, Canadian Undergraduate Mathematics Conference, 10–14 July 2013. Archived at Yumpu.com.

Indeed, within about an hour I filled up my browser with tabs marking possible illustrations for this column. For example, it turned out that CUMC organizers have digitized and uploaded several previous program booklets, including the one marking the conference's 20th anniversary. A researcher examining its pages could note the overall structure of the meeting, areas of research preferred by the graduate students of 2013, and the ways in which environmental concerns shaped the logistics of the conference.
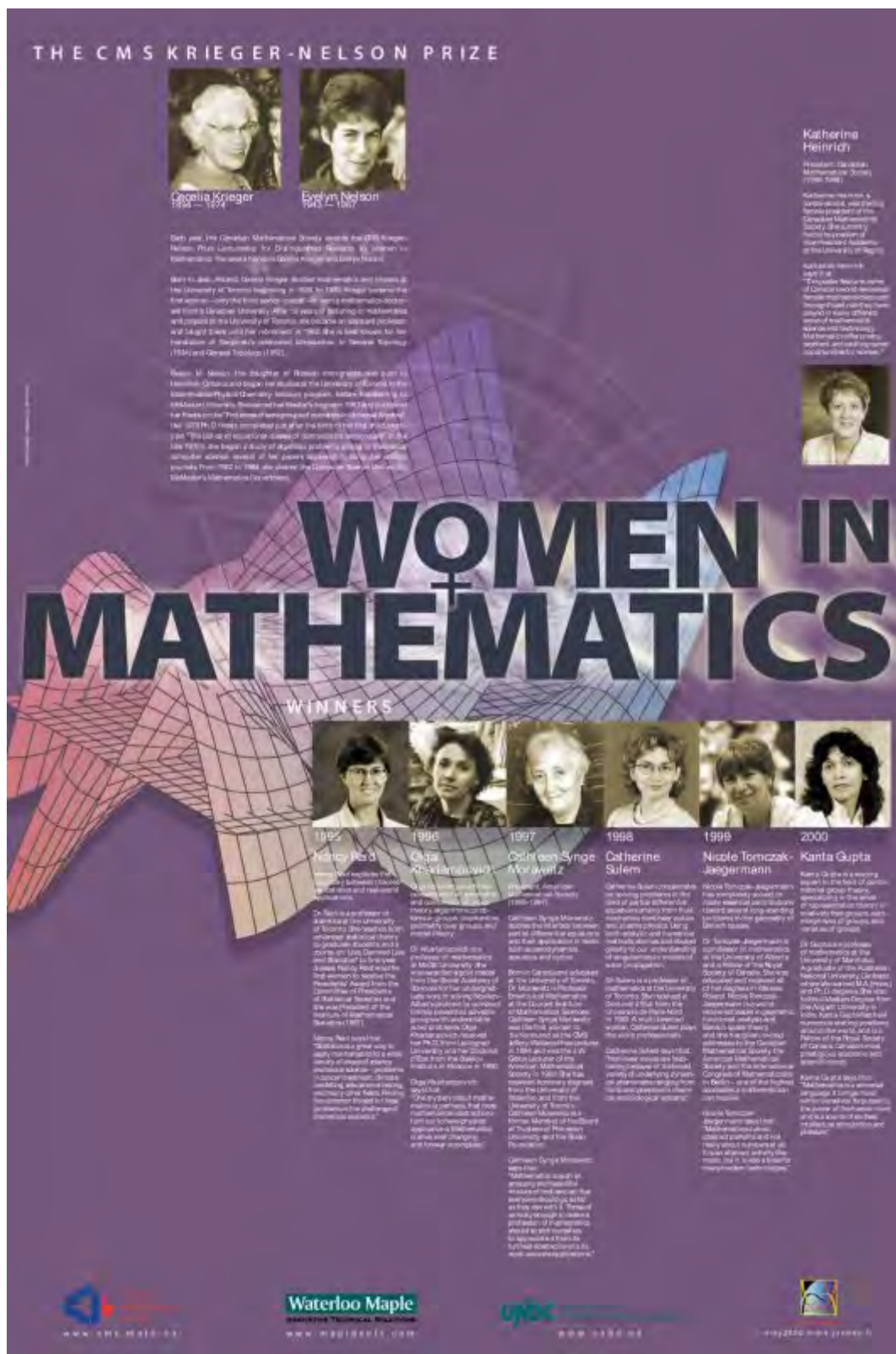
Figure 3. Canadian Mathematical Society, "Women in Mathematics: The CMS Krieger-Nelson Prize," 2000. *Math Central*, University of Regina and PIMS.

This 20-year-old poster depicts the winners of the Krieger-Nelson Prize from 1995 to 2000. While ephemera like this are produced to inspire students at the time of printing, these items might also be employed to instruct later generations. Students could update the biographies of these mathematicians, compare their fields of interest to those of scholars who have become prominent more recently, or research potential choices for a poster of women mathematicians at a different time in history.

The suggestions outlined here are developed in more depth in [2], which also contains sample worksheets for primary-source analysis. My main hope, though, is that readers will be motivated to seek out and think about the various types of potential primary sources that surround them every day.

Amy Ackerberg-Hastings co-edits "CSHPM Notes" with Hardy Grant, co-edits MAA Convergence with Janet Barnett, and researches the histories of mathematics education,

mathematical instruments, and women in science and mathematics. She developed and taught courses in historical methods and historical writing for University of Maryland Global Campus, where she mentored over 200 undergraduate history majors, and she has been active in the US National History Day program for 21 years.

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In 2021, the CMS will be electing eleven (11) officers and directors. Candidates have to agree to the nomination and provide the committee with biographical information.

You are invited to nominate members to be candidates and their nominations will be accepted by the Nominating Committee **prior to March 1, 2021** provided that each person nominated: (i) is supported in writing by at least five (5) other members of the CMS; and (ii) has given written acceptance to stand for office and to supply biographical information.

Nominations with supporting materials should be e-mailed to nominations-2021@cms.math.ca or sent to:

Nominating Committee Chair
Canadian Mathematical Society
209 – 1725 St. Laurent Blvd.
Ottawa, ON K1G 3V4 Canada

Nominations are being solicited for the following slate of candidates for the Executive Committee *(length of elected term in parentheses)*:

- President-Elect *(1 year)*/President *(2 years)*/Past-President *(1 year)*;
- Vice-President – Atlantic (N.B., P.E.I., N.S., N.L.) *(4 years)*; and
- Vice-President – Pacific (B.C., Yukon) *(4 years)*.

Nominations are also being solicited for Board of Directors members *(length of elected term in parentheses)*:

- Atlantic – 1 member *(4 years)*;
- Quebec – 1 member *(4 years)*;
- Ontario – 2 members *(4 years)*;
- West – 1 member *(4 years)*;
- Pacific – 2 members *(4 years)*; and
- Student – 1 member *(2 years)*.

The CMS will hold the election electronically in April 2021 and the results formally approved in June at the Annual General Meeting (AGM) in Ottawa, Ontario. Updated information will be periodically e-mailed to members and posted on the CMS website at on the Election page.

Alexandre Girouard
Chair, CMS Nominating Committee

The **CMS Blair Spearman Doctoral Prize** recognizes outstanding performance by a doctoral student. The prize is awarded to one recipient of a Ph.D. from a Canadian university whose overall performance in graduate school is judged to be the most outstanding. Although the dissertation will be the most important criterion (the impact of the results, the creativity of the work, the quality of exposition, etc.) it will not be the only one. Other publications, activities in support of students and other accomplishments will also be considered.

Nominees must have their Ph.D. conferred by a Canadian university in the year (January 1st to December 31st) preceding the nomination deadline. Nominations that were not successful in the first competition will be kept active for a further year (with no possibility of updating the file) and will be considered by the Doctoral Prize Selection Committee in the following year's competition.

The CMS Blair Spearman Doctoral Prize will consist of an award of $2,000, a two-year complimentary membership in the CMS, a framed certificate and a stipend for travel expenses to attend the CMS meeting to receive the award and present a plenary lecture.

Nominations

Candidates must be nominated by their university and the nominator is responsible for preparing the documentation described below, and submitting the nomination to the email address below.

CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues regardless of race, gender, ethnicity or sexual orientation. The deadline for the receipt of nominations is **January 31, 2021**.

The documentation shall consist of:

- A curriculum vitae prepared by the student.
- A resumé of the student's work written by the student and which must not exceed ten pages. The resumé should include a brief description of the thesis and why it is important, as well as of any other contributions made by the student while a doctoral student.
- Three letters of recommendation of which one should be from the thesis advisor and one from an external reviewer. A copy of the external examiner's report may be substituted for the latter. More than three letters of recommendation are not accepted.

All documentation, including letters of recommendation, should be submitted electronically, preferably in PDF format, **no later than January 31, 2021**, to **docprize@cms.math.ca**.

About the Award

The CMS Doctoral Prize is renamed as the CMS Blair Spearman Doctoral Prize in honour of the late mathematician, Dr. Blair Kenneth Spearman thanks to the Spearman Family who has generously pledged an endowment to the Canadian Mathematical Society in 2019 to fund the CMS Doctoral Prize.

Dr. Spearman was born on September 29, 1951, in Ottawa, Ontario. Although he did not discover the divine beauty of Mathematics until he was a third-year student at Carleton University, once he did, he devoted his life to it, finishing his Ph.D. at Penn State University in record time. He was a professor at University of British Columbia – Okanagan, receiving UBC Okanagan's first Teaching Excellence and Innovation Award, and consistently winning the same award year after year. He touched and changed so many of his students' careers and lives with his tireless effort and devotion. He was not only an exceptionally talented, first-rate mathematician who published over 115 mathematical papers in well-known journals, but also an absolutely wonderful and humble human being. His legacy will live on in those he left behind and will inspire young mathematicians to follow in his footsteps, strive for excellence, and be humble human beings.

In 1995, the Society established this award to recognize individuals who have made sustained and significant contributions to the Canadian mathematical community and, in particular, to the Canadian Mathematical Society. The award was renamed in 2008, in recognition of Graham Wright's 30 years of service to the Society as the Executive Director and Secretary.

CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues regardless of race, gender, ethnicity or sexual orientation.

Nominations should include a reasonably detailed rationale including three support letters and be submitted **by March 31, 2021**.

All documentation should be submitted electronically, preferably in PDF format, by the appropriate deadline, to gwaward@cms.math.ca.

Renewals

Individuals who made a nomination last year can renew this nomination by simply indicating their wish to do so by the deadline date. In this case, only updating materials need be provided as the original has been retained.

2020 Graham Wright Award for Distinguished Service Recipient

Claude Levesque
Laval University (retired)

Prof. Levesque is the most recent recipient of the award. Please read the Media Release. For a list of past recipients and to read their citations, please visit the official Graham Wright Award page.

Nominations of individuals or teams of individuals who have made significant and sustained contributions to mathematics education in Canada are solicited. Such contributions are to be interpreted in the broadest possible sense and might include: community outreach programs, the development of a new program in either an academic or industrial setting, publicizing mathematics so as to make mathematics accessible to the general public, developing mathematics displays, establishing and supporting mathematics conferences and competitions for students, etc.

CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues regardless of race, gender, ethnicity or sexual orientation.

Nominations must be received by the CMS Office **no later than April 30, 2021**.

Please submit your nomination electronically, preferably in PDF format, to apaward@cms.math.ca.

Nomination requirements

- Include contact information for both nominee and nominator.
- Describe the nominated individual's or team's sustained contributions to mathematics education. This description should provide some indication of the time period over which these activities have been undertaken and some evidence of the success of these contributions. This information must not exceed four pages.
- Two letters of support from individuals other than the nominator should be included with the nomination.
- Curricula vitae should not be submitted since the information from them relevant to contributions to mathematics education should be included in the nomination form and the other documents mentioned above.
- If nomination was made in the previous year, please indicate this.
- Members of the CMS Education Committee will not be considered for the award during their tenure on the committee.

Renewals

Individuals who made a nomination last year can renew this nomination by simply indicating their wish to do so by the deadline date. In this case, only updating materials need be provided as the original has been retained.

2020 Adrien Pouliot Award Recipient
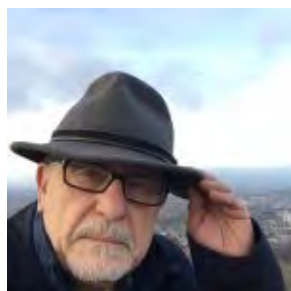
Veselin Jungic
Simon Fraser University

Prof. Jungic is the most recent recipient of the award. Please read the Media Release or his citation. For a list of past recipients and to read their citations, please visit the official Adrien Pouliot Award page.

The CMS invites expressions of interest for the Editor-In-Chief (EIC) of the *Canadian Journal of Mathematics* (CJM); **two Editors-in-Chief are being solicited**, with a five-year term to commence January 1, 2022 and some partial funding support from the CMS is available for both these EIC positions.

Since 1949, the *Canadian Journal of Mathematics* has been committed to publishing original mathematical research of high standard following rigorous academic peer review. New research papers are published continuously online and are collated into print issues six times each year. CJM and CMB (*Canadian Mathematical Bulletin*) are supported by respective Editors-in-Chief and share a common Editorial Board.

Expressions of interest should include a cover letter, your curriculum vitae, and an expression of views regarding the publication. Since being EIC of CJM is a large responsibility that may require a lessening of responsibilities in an individual's normal work, individuals should review their candidacy with their university department and include a letter of support.

Please submit your expression of interest electronically to: CJM-EIC-2020@cms.math.ca **before April 15, 2021**.

For more information, please contact us at the email address above.

Alex Zhuoqun Song (Citadel LLC)
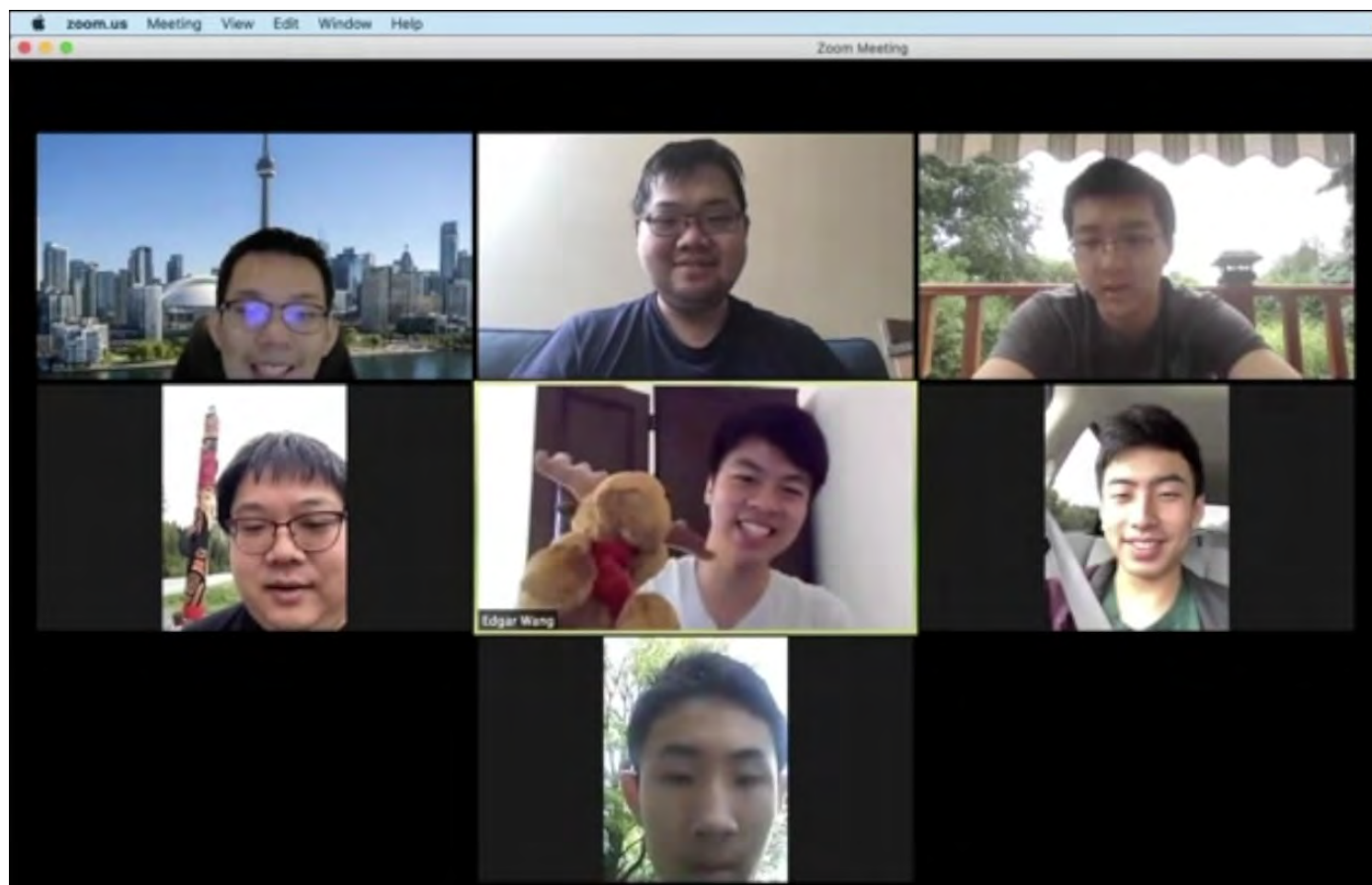
Annually, Canada participates in the International Mathematical Olympiad (IMO), the premier math competition for young mathematicians in high school. The competition spans two consecutive days, and the students are tasked with solving three questions on each day. This year, the IMO is hosted by Russia, and was originally scheduled to be held in Saint Petersburg in July. However, due to the coronavirus outbreak worldwide, the IMO was rescheduled to be a remote competition, and it was held September 19 to 28, 2020, with the contest itself being held on September 21 and 22.

In advance of the competition, we had selected our team of students through our national mathematical olympiad (CMO), the Asia-Pacific Math Olympiad (APMO), and a final team selection test held for the top students after the first two competitions. This year, the team consists of Thomas Guo, Michael Li, Eric Shen, David Tang (of the Greater Toronto Area), Edgar Wang (of Montreal), and Zixiang (Peter) Zhou (of London), and in addition to myself, Byung Chun is the deputy leader for the team.

After having selected the team in June, we had a couple months of online preparation, where the students attended problem-solving sessions and did practice tests hosted by Victor Rong (a contestant for Team Canada at IMO 2017-2019) and myself. We covered many topics that are likely to appear on the exam, including ample preparation in each of the IMO problem categories, algebra, combinatorics, geometry, and number theory.

Typically, the leaders from each country first select the test democratically, but due to the exam being remote, the host country has selected the test before the IMO. Then, leaders form committees to translate the test to the languages in which their students are taking the test. Fortunately for me, everyone on the team opted to take the test in English, which is one of the languages already provided by the host country. The students then gather at national testing sites to take the tests; Edgar took the test in Boston, one of the testing sites in the United States, while our other team members took the test in Toronto. Ed Barbeau and Dani Spivak hosted our Toronto testing site, coordinating with the IMO organizers and invigilators to maintain a fair and monitored testing situation for the students.

After the test, the students would typically go on excursions and attend mathematical talks by top mathematicians, organized by the host country. This year, the IMO organizers invited Timothy Gowers, Lisa Sauermann, Jozsef Pelikan, Stanislav Smirnov, Grant Sanderson, and Nikolay Andreev to speak to the students remotely; the students would submit questions ahead of time for the speakers to answer in addition to the mathematical talk. In place of excursions, the IMO organizers hosted video tours of varous landmarks in Saint Petersburg, and also hosted a chess tournament among other fun events.

While the students were participating in the events post-competition, the leaders and IMO coordinators grade the students' papers. Unlike a typical exam, each paper is graded both by the contestants' leaders as well as the host country's coordinators, and if the proposed scores disagree, a discussion ensues where the leaders make their

case to the coordinators, who then revisit the paper to decide on the final score. This year, such discussions were hosted online on the IMO website, with the option to move to video software if preliminary discussions were inconclusive. This year, coordination for the Canadian team went extremely smoothly, in part due to the precision of the rubric in covering various approaches to the problems on the tests.

The Canadian team placed 12th, achieving three gold medals (Thomas, Michael, Eric), one silver medal (Zixiang), and two bronze medals (David, Edgar). The top team this year was China, and the top score was achieved by Jinmin Li of China.

Here is Problem 3, the hardest problem of the first day of the test: There are $4n$ pebbles of weights 1, 2, 3, ..., $4n$. Each pebble is coloured in one of n colours and there are four pebbles of each colour. Show that we can arrange the pebbles into two piles so that the total weights of both piles are the same, and each pile caontains two pebbles of each colour.

Sarah Watson

Meetings and Events Manager

2020 has been a year of firsts for CMS Competitions! Due to the pandemic, our national teams competed in the first online European Girls Mathematical Olympiad (EGMO) and the first online International Mathematical Olympiad (IMO). This year, the CMS also introduced a new competition called the Canadian Mathematical Gray Jay Competition(CMGC) aimed at younger students wishing to compete in a fall math competition. This competition was created to capture the interest of young students who are passionate about mathematics and to celebrate 75 years of CMS!

The EGMO was slated to take place in Egmond aan Zee, Netherlands from April 15 to 21, but quickly pivoted to a virtual competition. The training camp took place in Toronto at the Fields Institute this past February with Leader Dorette Pronk (Dalhousie) and Deputy Leader Diana Costaneda Santos (Waterloo) training our 2020 team; Anna Krokhine, Siyu (Elaine) Liu, Jennifer Wang and Amelie Zhou. There were many other individuals who helped with the training including Daniel Spivak, Jacob Tsimerman, Mike Pawliuk, Lindsey Shorser, and Byung Chun.

The competition started with virtual opening ceremonies and the leaders worked with the parents to supervise the students. The girls worked hard and won one silver for Jennifer, one bronze for Anna and an honourable mention for Elaine. Deputy Leader, Diana Castaneda Santos, was very pleased with the results and said: Our team came up with unique and original solutions to some of the problems and I was impressed to see the level of creativity and involvement from all the members on our team." She acknowledged the challenges of writing the competition virtually under COVID restrictions: "Under these new conditions, we all adjusted our schedules and managed to stay connected each day of the competition. I am glad that our team succeeded in this competition. Their efforts and commitment during the competition and the days following show the effectiveness of EGMO in keeping math discussions active among our girls."

See the EGMO report for more information.

The CMS also sent a team to participate in the CMC (Cyberspace Mathematical Competition) put on by the MAA. With 8 team members including 2 girls, Canada placed 9th out of 75 countries or 4th by medal counts.

This year the CMS successfully held a Canadian Junior Mathematical Olympiad (CJMO) to support younger students in an Olympiad style competition. The invitation to the CJMO was based on the results of the 2019 COMC and the Repechage. Invitees are students in grade 10 and below. The CJMO was written at the same time as the CMO on Thursday March 12th, 2020. A total of 10 students from 17 schools wrote the competition.

The IMO was slated to take place in St. Petersburg, Russian Federation in July, but made the decision to hold the competitions virtually in September. The team members this year were Thomas Guo, Michael Li, Zixiang (Peter) Zhou, Edgar Wang, Eric Shen and David Tang. The IMO regulations determined that all students must write from an IMO testing location. The Fields Institute in Toronto graciously allowed CMS and the IMO team to use their facilities to write the competition. Bryan Eelhard at Fields was instrumental in helping to make this happen. This year's team was coached by leaders and previous IMO medal winners, Alex Song (Citadel LLC) and Byung Chun (Royal St. George's College) and assisted by Victor Rong in the training.

The opening ceremony for the IMO took place on September 20th online and the contest was held from September 21st to the 22nd at each country's writing centres. Since our leaders could not travel to the destination due to COVID restrictions, some CMS friends, including Ed Barbeau, Dani Spivak, and Bryan Eelhard, helped to invigilate the competition. Given the extraordinary circumstances in which the team wrote the two day competition, it was a great year for Canada! We tied our medal record from 2012 with 3 gold, 1 silver and 2 bronze. James Rickards, the chair of the IMO committee rejoiced at the results:"Despite the new challenges, the Canadian team had one of the best performances in our history!".

Ed Barbeau who helped to invigilate said "I was impressed with the smoothness of the operation, considering that the IMO organizers had to collaborate with 100 countries and supervise even more test venues. Also, I am very grateful to the Fields Institute for providing the facilities and looking after the technical arrangements. The conditions were comfortable for the students."

See the IMO report for more information.

Given the circumstances this year, the CMS decided that the COMC and the new Gray Jay Competition would be offered both online and in person. This new virtual format took a tremendous amount of work and effort but it allowed for the participation of a great number of students who would not have been able to write the exam otherwise.

The new Canadian Mathematical Gray Jay Competition was aimed at students in grades 5-8 but any student was welcome to compete. CMS formed a new Gray Jay Committee with mathematicians from across Canada to create an exam with 15 multiple-choice questions. Overall, Gray Jay had 2204 exams purchased across Canada and internationally. 1279 of those were online and 925 print exams. It was a very successful first year.

This year, the CMS formed a new partnership with the Thai-Canadian Alumni Association which ran our competitions in Thailand with great success! Many Thai students were excited to participate in a Canadian competition for the first time.

This year's pandemic created a very tough situation for teachers across the country and many schools could not participate in COMC. Schools that still participated did so either online or with smaller cohorts of students. Overall, there were 2317 online exams written and 3526 paper exams written across Canada and internationally. Marking is currently underway for COMC and we look forward to announcing the results soon.

**Canadian Mathematical Society
Société mathématique du Canada**

2020 CMS
Winter Meeting
Réunion d'hiver
DE LA SMC 2020

VIRTUAL MEETING | RÉUNION VIRTUELLE

DECEMBER 3-8 DÉCEMBRE, 2020

PLENARY SPEAKERS | CONFÉRENCES PLÉNIERES

Nicolas Bergeron (École Normale Supérieure)
Irene Fonseca (CNA)
Yvan Saint Aubin (Université de Montréal)

MITACS PUBLIC LECTURE | CONFÉRENCE PUBLIQUE MITACS

Alicia Carriquiry (Iowa State)

PRIZES | PRIX

DOCTORAL PRIZE LECTURE | CONFÉRENCE DE PRIX DE DOCTORAT
Duncan Dauvergne (Princeton University)

COXETER JAMES PRIZE | CONFÉRENCE DE PRIX DE COXETER-JAMES
Jacopo De Simoi (University of Toronto)

ADRIEN POULIOT PRIZE | CONFÉRENCE DE PRIX ADRIEN-POULIOT
Veselin Jungic (Simon Fraser University)

GRAHAM WRIGHT AWARD FOR DISTINGUISHED SERVICE | PRIX GRAHAM-WRIGHT POUR SERVICE MÉRITOIRE
Claude Levesque (Laval)

SCIENTIFIC DIRECTORS | DIRECTEURS SCIENTIFIQUES

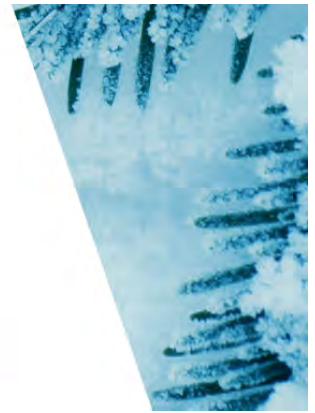Michael Lipnowski (McGill Univeristy)
Brent Pym (McGill University)

Adrien Pouliot Award

Veselin Jungic

Dr. Jungic receives the Adrien Poulio Award in recognition of his outstanding contributions to mathematics education. Throughout his career, Dr. Jungic has pushed forward our understanding of mathematics education and implemented practical solutions for teaching. He has documented his work in a series of over 40 math education-related publications in order to share his experiences with others.

Veselin Jungic, also known lovingly as Veso in the mathematics community, is a Teaching Professor at the Department of Mathematics, Simon Fraser University. He has been teaching mathematics at the post-secondary level since 1978. Dr. Jungic is a 3M National Teaching Fellow and a recipient of several teaching awards, including the Canadian Mathematical Society Teaching Award and the Pacific Institute for Mathematical Sciences Educational Award. Most of his research is in Ramsey theory and the field of mathematics education and outreach. He has authored and coauthored papers with numerous educational themes, mostly based on his own teaching practices.

CMS Excellence in Teaching Award

Joseph Khoury

Dr. Khoury has been a lecturer at the University of Ottawa for over 20 years. He received his B.Sc. (Hons.) from the Lebanese University in Beirut and his Ph.D. from the University of Ottawa in 2001, for a thesis focused on types of locally nilpotent derivations, a subject linked to Commutative Algebra and Algebraic Geometry.

Since 2001, Dr. Khoury has also held the position of coordinator of Math Help Centre in the Department of Mathematics and Statistics at the University of Ottawa where he also leads the department's outreach program. He has received many awards and honours throughout his career including the Part-Time Professor of Year Award, which is the University of Ottawa's most prestigious award for teaching by a Lecturer, the Outstanding Contribution to Students' Experience Award, and the CMS Distinguished Service Award. He has inspired countless students and many colleagues with his passion for teaching and mathematics education.

Coxeter-James Prize

Jacopo De Simoi

Dr. Jacopo De Simoi (Toronto) has been named the recipient of the 2020 Coxeter-James Prize for his work in the area of dynamical systems. Dr. De Simoi works mainly in the field of dynamical systems but he has very wide interests spanning from the study of near integrable systems to strongly chaotic ones. He has worked on some of the most prominent outstanding problems in the field, from the study of the standard map to the statistical properties of partially hyperbolic systems.

After obtaining Bachelor's and Masters' degrees in Physics from the University of Pisa in Italy, Jacopo De Simoi received his Ph.D. in mathematics from the University of Maryland in 2009. He has held postdoctoral positions in Paris, Rome, and Toronto, before moving to the University of Toronto in Mississauga, where he has been assistant professor since 2016.

Doctoral Prize
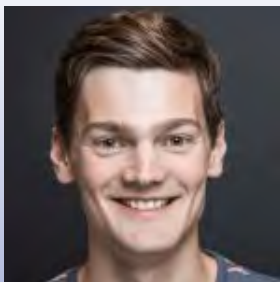
Duncan Dauvergne

Duncan Dauvergne is an exceptional mathematician whose recently completed PhD thesis comprises several outstanding results unexpected at this stage of one's career. Duncan solved, or significantly contributed to solving, three open problems in probability explaining, among other things, a phenomenon that tantalized researchers in probability, combinatorics and statistical physics. This phenomenon is, in essence, that random systems behave in surprisingly non-random ways.

Duncan Dauvergne completed his PhD at the University of Toronto under the supervision of Bálint Virág in 2019. He is the author and co-author of several articles published in professional journals such as *The Annals of Probability*, *Annales de l'Institute Henri Poincaré*, and *Transactions of the AMS*. Since September 2019, Duncan Dauvergne is an instructor and NSERC postdoctoral fellow at Princeton University.

G. de B. Robinson Award

Chao Zhang

Professor Chao Zhang is being recognized for his paper "Ekedahl-Oort Strata for Good Reductions of Shimura Varieties of Hodge Type" (*Canad. J. Math.* 70 (2018), no. 1, 451-480).

Dr. Zhang is currently an Associate Professor of Shing-Tung Yau Center of Southeast University in Nanjing, China. After finishing his graduate study in China, he received a scholarship from the Erasmus Mundus ALGANT-DOC doctoral program, and became a Ph.D. student at Leiden University and at the University of Milan, with advisors Prof. Bas Edixhoven and Prof. Fabrizio Andreatta. Upon obtaining his Ph.D. in 2013, he started a postdoc in the Yau Mathematical Sciences Center (Tsinghua University, Beijing) and the Institute of Mathematics of Academia Sinica (Taipei). He joined Southeast University in December 2019.

Graham Wright Award for Distinguished Service
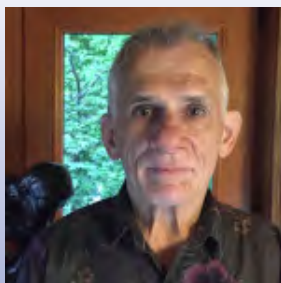
Claude Levesque

Claude Levesque has made sustained and distinguished contributions to the Canadian mathematical community and, in particular, to the Canadian Mathematical Society (CMS) in numerous ways.

Dr. Levesque finished his undergraduate studies at Université Laval in 1970 where he then continued his studies and received his Master's degree in mathematics in 1973. In the following years, Dr. Levesque completed his Ph.D. at the Illinois Institute of Technology. He has been teaching at Laval University since 1986, but has served as invited professors in many different universities such as University of Hawaii, Concordia University and University of Saga.

Jeffery-Williams Prize

Juncheng Wei

Dr. Wei has been named the recipient of the 2020 CMS Jeffery-Williams Prize for his exceptional contributions to the theoretical development and interdisciplinary applications of nonlinear partial differential equations. Dr. Wei's research is remarkable in its breadth, depth, originality and influence. It is broadly concerned with developing tools of mathematical analysis and applying them to shed light on phenomena in physics and biology, which are described by mathematical models.

Juncheng Wei received his Ph.D. in mathematics from the University of Minnesota in 1994. He was postdoctoral fellow at SISSA in Italy before becoming professor at the Chinese University of Hong Kong, where he worked from 1995 until 2012. Since 2012, he has been Canada Research Chair (Tier I) at UBC.

Krieger-Nelson Prize

Sujatha Ramdorai

Dr. Ramdorai has been named the recipient of the 2020 Krieger-Nelson Prize for her exceptional contributions to mathematics research. Dr. Ramdorai (or Sujatha, as she prefers to be known) is a versatile, creative and technically powerful mathematician. She is awarded the Krieger-Nelson Prize for her work that covers a broad range of subjects, including motives, K-theory and arithmetic geometry.

About a decade ago, Sujatha joined the Mathematics Department at the University of British Columbia as a Tier I Canada Research Chair. At the UBC, she continued her work on motives, K-theory and Iwasawa theory. In recent years, Sujatha has become a bridge between Canadian and Indian mathematical landscapes and has played an important role in opening up opportunities for junior researchers in both countries.

Invitation to celebrate the International Day of Mathematics (IDM)
March 14 2021
Invitation à célébrer la Journée internationale des mathématiques (JIM)
le 14 mars 2021
www.idm314.org

The IDM 2021 theme is:
Mathematics for a Better World

Your school is invited to celebrate the International Day of Mathematics around March 14 2021 (for instance on Friday March 12 or Monday March 15 since March 14 is a Sunday).

One way to celebrate is to participate to the poster challenge:
https://www.idm314.org/2021-poster-challenge.html
Then you can use the poster in your school. The IDM logo can be found on the IDM website at:
https://www.idm314.org/press_kit.html

In a few weeks, the website will present activities related to the theme that you can use for classroom activities.

An international online day will be held like the IMD 2020 day:
https://www.idm314.org/launch-2020.html

To receive the IDM 2021 information, subscribe to the newsletter on the website.

We hope that your school will celebrate! If yes, announce it on the website.

Le thème de la JIM 2021 est :
Les mathématiques pour un monde meilleur

Votre école est invitée à célébrer la Journée internationale des mathématiques vers le 14 mars 2021 (par exemple le vendredi 12 mars ou le lundi 15 mars, car le 14 mars est un dimanche).

L'une des façons de célébrer est de participer au défi d'affiches :
https://www.idm314.org/2021-poster-challenge-fr.html
Vous pourrez alors utiliser l'affiche dans votre école. Le logo de la JIM se trouve à :
https://www.idm314.org/press_kit.html

Le site web présentera bientôt des activités et projets liés au thème que vous pourrez utiliser pour des activités en classe.

Une journée en ligne se tiendra comme celle de la JIM 2020:
https://www.idm314.org/launch-2020.html

Pour recevoir les informations sur la JIM 2021, inscrivez-vous à l'infolettre.

Nous espérons que votre école célébrera ! Si oui, annoncez-le sur le site.

Last year, members of the CMS Board of Directors, staff members and friends of the CMS took time to contact current and past members of the Society (either by email or phone) and thank them for their participation in CMS activities and to encourage them to renew their CMS membership (if they hadn't already done so). This friend-raising and fundraising campaign was very successful and gave members a chance to comment upon what they enjoyed about belonging to the society, as well as constructive advice on how the Society could be improved.

Once again, at the close of the year, the CMS wishes to thank the Canadian mathematical community for its contribution as support. This year, many CMS programs have had to be cancelled or changed and the Society created new programs to meet the new needs of the community stricken now by a global pandemic and the health restrictions that it had imposed. The CMS needs your help now more than ever to continue to thrive and serve both young and established researchers and educators and to foster interest in mathematics in the young generation. If you are not yet a member of the CMS we encourage you to be come one and enjoy the advantages of a CMS membership. If you are already a member we invite you members to give as generously as possible to the CMS.

With your regular donations, as well as those from foundations, corporations, governments and institutions, the CMS programs and activities will be expanded as will our ability to truly represent the full community of Mathematicians in Canada.

The CMS encourages you to consider donations through Planned Giving.

You can also help by:

- If you have contacts in private industry or with foundations, with whom the CMS can form potential partnerships, please communicate this information to Zishad Lak, CMS Fundraising and Communications Officer.
- If you are interested in volunteering for a CMS committee, please contact the Chair of the Nominating Committee, Alexandre Girouard (Laval) – chair-nomc@cms.math.ca
- Encourage colleagues to become members of the CMS!

Working together, we can continue to promote the advancement, discovery, learning, and application of mathematics. If you have questions or want more information, please contact Zishad Lak at zlak@cms.math.ca

Department of Applied Mathematics
University of Waterloo

The Department of Applied Mathematics in the Faculty of Mathematics at the University of Waterloo invites applications for a tenure-track position at the rank of Assistant Professor, and in special cases Associate or Full Professor. Exceptional candidates with broad interests in all areas of applied mathematics (these include Fluid Dynamics, Control & Dynamical Systems, Mathematical Medicine & Biology, Mathematical Physics and Scientific Computing) that enhance the research and teaching portfolio of the Department are invited to apply.

The successful candidate will be expected to establish an outstanding research program. Experience with interdisciplinary or industrial applications is of particular interest. We are looking for applicants with an enthusiasm for teaching at both the undergraduate and graduate level, and for the supervision of graduate and undergraduate research.

The Department of Applied Mathematics is one of four departments, together with a School of Computer Science, that comprise the Faculty of Mathematics at the University of Waterloo. The Faculty was ranked 41st in the world for mathematics (20th in N. America, and 3rd in Canada) in the 2020 QS World University Rankings. The department has 28 regular faculty whose research interests include control theory, differential equations and dynamical systems, fluid dynamics, mathematical biology & medicine, mathematical physics, and scientific computing. Research in the department is enhanced by interdisciplinary and industrial collaborations and links to interdisciplinary institutes including the Centre for Computational Mathematics in Industry and Commerce. The department has a substantial graduate program with over 135 graduate students pursuing Masters or PhD degrees, and strong undergraduate programs in applied mathematics, scientific computation and mathematical physics. More information about the department can be found at http://math.uwaterloo.ca/applied-mathematics/.

Candidates interested in this position should have a PhD or equivalent in Applied Mathematics or a related field. The salary range for this position is $100,000-$160,000. Salary will be commensurate with qualifications, experience and research record. Negotiations beyond this salary range will be considered for exceptionally qualified candidates. The effective date of appointment is July 1, 2021.

Interested individuals should apply using MathJobs. Applications should include a cover letter, a curriculum vitae, research and teaching statements, teaching evaluation summaries (if available) and up to three reprints/preprints. In addition, applicants should arrange to have at least three reference letters submitted on their behalf. Completed applications will be reviewed on an ongoing basis. The application deadline is **December 23, 2020**.

The University of Waterloo understands the impact that career interruptions (e.g. parental leave, leave due to illness) can have on a candidate's achievement and encourages potential candidates to explain in their application the impact this may have on their record; this information will be taken into careful consideration during the assessment process.

If you have any questions regarding the position, the application process, assessment process, eligibility, or a request for accommodation during the hiring process, please contact:
Dr. Siv Sivaloganathan, Chair, Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1 (am-chair@uwaterloo.ca)

The University of Waterloo regards equity and diversity as an integral part of academic excellence and is committed to accessibility for all employees. As such, we encourage applications from women, persons with disabilities, Indigenous peoples, members of visible minorities, and others who may contribute to the further diversification of ideas. At Waterloo, you will have the opportunity to work across disciplines and collaborate with an international community of scholars and a diverse student body, situated in a rapidly growing community that has been termed a "hub of innovation."

All qualified candidates are encouraged to apply, however Canadians and permanent residents will be given priority.

Three reasons to apply: https://uwaterloo.ca/faculty-association/why-waterloo.

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No responsibility for the views expressed by authors is assumed by the *CMS Notes*, the editors or the CMS.

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