



2019 IMO Leader's Report . . . 14

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CMS NOTES de la SMC

December /
décembre
2019

Executive Director's Notes / Notes de la Directrice générale

Termeh Kousha (Ottawa)

Executive Director, CMS / Directrice générale - SMC

2019 is prime



As the year-end is approaching and the CMS is getting ready to celebrate its 75th birthday in 2020, I am looking back at my first year as the Executive Director of the CMS and the CMS' achievements in the past year.

Promoting math among young girls and other underrepresented groups was one of the principal objectives of the CMS in 2019. The Society is aspiring to change the STEM culture and create a suitable and diverse environment for all students and educators by sponsoring a large range of educational activities and encouraging student participation. While the International Mathematical Olympiad (IMO) is accessible to students of all genders, participating in European Girls' Mathematical Olympiad (EGMO) competitions offers female students an additional opportunity to showcase their mathematical talent. In February, with the generous support of University of Waterloo, the CMS held its first training camp for Girls' Math Team Canada at the Fields Institute. This was the second consecutive year that Canadian girls were participating in the EGMO. It was a proud moment for Canada, the CMS, and girls in math; Canadian All Girls Math Team shined on the international stage and returned from Ukraine with two Bronze Medals and two Honourable Mentions. EGMO and training camps have a crucial impact on encouraging girls to compete at the highest levels and help change the culture of mathematics education. The CMS is counting on the continuation of these programs in the

2019: Une année singulière

With the end of the year which is approaching and the preparations for the 75th anniversary of the SMC, I reflect on my first year as the Executive Director of the SMC and the accomplishments of the Society in 2019.

The promotion of mathematics among girls and other underrepresented groups was one of the main objectives of the CMS in 2019. The Society is aiming to change the STEM culture and create a suitable and diverse environment for all students and educators by sponsoring a wide range of educational activities and encouraging student participation. While the International Mathematical Olympiad (IMO) is accessible to students of all genders, participating in European Girls' Mathematical Olympiad (EGMO) offers female students an additional opportunity to showcase their mathematical talent. In February, with the generous support of University of Waterloo, the CMS held its first training camp for Girls' Math Team Canada at the Fields Institute. This was the second consecutive year that Canadian girls participated in the EGMO. It was a proud moment for Canada, the CMS, and girls in math; Canadian All Girls Math Team shone on the international stage and returned from Ukraine with two Bronze Medals and two Honourable Mentions. EGMO and training camps have a crucial impact on encouraging girls to compete at the highest levels and help change the culture of mathematics education. The CMS is counting on the continuation of these programs in the

A Few Of My Favorite Manipulatives

Robert Dawson, St. Mary's
CMS Notes Editor-in-Chief



Over the years, I've had occasion to work with grade school math teachers on various projects. As you're probably aware, they do some things differently there. One big difference between university and grade school math teaching is the emphasis on what the teachers call "manipulatives" - physical objects that help students learn a concept.

These include things like "base ten tiles" - unit squares, one-by-ten rods, and ten-by-ten slabs, used to illustrate positional notation. The same tiles - or similar ones with different proportions - make an appearance again in high school to illustrate the factoring of a quadratic: how do you arrange two big squares, five rods, and six little squares into a rectangle? And then there are the red and black chips used to illustrate integer operations - black chips are positive, red chips are negative, and you can remove or introduce a balanced set (equal numbers of red and black) at any time. It might sound trivial, but it's a first introduction to the mathematics of adding a formal inverse to a structure. Constructing a ring of fractions, or any other sort of localization, is in a sense just an extension of that idea.

Many of these gadgets, of course, are just introductions, something to do in the first class on a new topic. Computing even (say) 23-45 using red and black chips could be tiresome. But there are some manipulatives (even if we don't always think of them as such) that don't lose their play value fast. The classic example must be the compass and straightedge of Greek geometry. These still form an important part of the curriculum of school geometry classes. Moreover, the problem of what can and cannot be constructed with these tools motivated more than two millennia of research. Even when Wantzel gave a complete answer in 1837, related questions sprang up - what can you do with compass alone? straightedge alone? a marked straightedge? origami? linkages?

And then there's the slide rule. Yes, the slide rule was designed for purely practical purposes, and for a long time it was almost as ubiquitous in laboratories as computers are today. But watch a multiplication being done with a slide rule and you can really see how logarithms work. Perhaps the old slipstick deserves to be revived in high school classrooms, just for that purpose!

Quelques-uns de mes matériaux de manipulation préférés

u fil des ans, j'ai eu l'occasion de travailler sur différents projets avec des enseignant.e.s en mathématiques au primaire.

Comme vous le savez probablement, l'enseignement au primaire est bien différent de celui aux études supérieures. L'une des différences majeures est l'importance au primaire de ce que les enseignant.e.s appellent matériel de manipulation - des objets physiques qui aident les élèves à apprendre certains concepts.

Ceux-ci comprennent des objets comme les « cubes multibase » – des cubes unités, des réglettes de dizaines, des plaquettes de centaines, etc. – qu'on utilise pour illustrer la notation positionnelle. Les mêmes cubes apparaissent dans l'enseignement au secondaire afin d'illustrer la factorisation d'une équation quadratique : comment arranger deux plaquettes, cinq réglettes et six petits cubes pour former un rectangle? Il y a aussi les jetons rouges et noirs dont le but est d'illustrer les opérations sur les entiers. Les jetons noirs représentent les nombres positifs et les rouges les nombres négatifs et on peut les additionner ou les retrancher en quantité égale. Cela peut sembler insignifiant, mais c'est véritablement une première introduction à la notion d'inverse. Construire un anneau de division, ou n'importe quelle localisation est, en un sens, une extension de cette idée.

Plusieurs de ces objets sont, bien sûr, de simples introductions, des éléments utiles pour un premier cours sur un nouveau sujet. Faire des calculs un peu plus grands, disons 23-45, en utilisant des jetons rouges et noirs devient rapidement ennuyeux. Pourtant, il y a des matériaux de manipulation (même si au premier regard ils ne nous en apparaissent pas comme tel) qui ne perdent pas si vite de leur intérêt. Un exemple classique est la règle et le compas qu'on utilise en géométrie euclidienne. En effet, plus de deux-mille ans de recherche se penchent sur ce qui est possible ou impossible de construire avec ces outils. Même quand Wantzel trouva une solution complète à cette question, d'autres surgirent : qu'en est-il d'un compas, d'une règle, d'une règle graduée, des plis possibles en origami ou encore des liaisons mécaniques?

Enfin, il y a la règle à calculer. Certes, cette règle a été conçue pour des raisons strictement pratiques et pendant longtemps on la trouvait partout dans les laboratoires, au même titre que les ordinateurs aujourd'hui. En regardant une multiplication faite sur une règle, on peut vraiment comprendre comment les logarithmes fonctionnent. Peut-être que cet objet de manipulation mériterait d'être ressuscité et retourné dans les salles de cours, juste pour cela!

2020 CMS MEMBERSHIP RENEWALS



The 2020 membership renewals have been sent! Please renew your membership online at portal.cms.math.ca by logging into your member account. Should you have any questions, please email us at memberships@cms.math.ca

RENOUVELLEMENTS 2020 À LA SMC

Le renouvellement pour l'an 2020 a été envoyé! S'il vous plaît renouveler votre adhésion en ligne à portail.smc.math.ca et en vous connectant à votre compte de membre. Si vous avez des questions, s'il vous plaît écrivez-nous à adhesions@smc.math.ca

Letters to the Editors

The Editors of the NOTES welcome letters in English or French on any subject of mathematical interest but reserve the right to condense them. Those accepted for publication will appear in the language of submission. Readers may reach us at the Executive Office or at notes-letters@cms.math.ca

Lettres aux Rédacteurs

Les rédacteurs et les rédactrices des NOTES acceptent les lettres en français ou en anglais portant sur n'importe quel sujet d'intérêt mathématique, mais ils se réservent le droit de les comprimer. Les lettres acceptées paraîtront dans la langue soumise. Le lectorat peut nous joindre au bureau administratif de la SMC ou à l'adresse suivante : notes-lettres@smc.math.ca.

NOTES DE LA SMC

Les Notes de la SMC sont publiés par la Société mathématique du Canada (SMC) six fois par année (février, mars/avril, juin, septembre, octobre/novembre et décembre).

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Les Notes de la SMC, les rédacteurs et la SMC ne peuvent pas être tenus responsables des opinions exprimées par les auteurs.

CMS NOTES

The CMS Notes is published by the Canadian Mathematical Society (CMS) six times a year (February, March/April, June, September, October/November and December).

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La Société mathématique du Canada appuie l'avancement, la découverte, l'apprentissage et l'application des mathématiques. L'exécutif de la SMC encourage les questions, commentaires et suggestions des membres de la SMC et de la communauté.

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The CMS promotes the advancement, discovery, learning and application of mathematics. The CMS Executive welcomes queries, comments and suggestions from CMS members and the community.

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Continued from cover

years to come. Special thanks are due to this year's Team Leader Professor Dorette Pronk and all other sponsors and volunteers who supported these young talented girls.

On a more national level, the CMS Math Camps are expanding. The CMS is proud to have at least one camp in every Canadian province, several in some provinces, targeting students from different groups and backgrounds. In 2019, with the support of PromoScience and the RBC Foundation grants, the CMS was able to organize its first Math Camp for Northern communities and Indigenous students in the Yukon. Thanks to Dr. Joseph Khoury (the Chair of Education Committee) and Dana Mills (Youth STEM Outreach Coordinator at Yukon College) the Camp was a huge success. The CMS is also planning to organize two new camps in 2020, one in the Yukon and another in the Northwest Territories.

Another CMS goal has been to make educational material accessible to a greater number of students. With the support of the Intact Foundation, the CMS was able to make *Crux Mathematicorum (CRUX)*, an internationally respected problem solving journal, available as a free educational online publication as of January 2019. Therefore, every high school teacher and student in Canada and globally is now able to access *CRUX* as a free and educational math resource. Thanks to Dr. Kseniya Garaschuk (Editor-in-Chief of CRUX) for her great work and dedication to this journal. The journal also helps teachers prepare their students for various CMS competitions.

In 2018, a record number of students in Canada and abroad wrote the Canadian Open Mathematics Challenge (COMC). This year, in order to increase participation of students at all levels of math proficiency in the COMC and to create a larger and more diverse pool to choose Math Team Canada, the CMS sent invitation letters to high school principals and math teachers across Canada and invited them to participate in this prestigious national competition. The Society is happy to provide, through the competitions, an engaging way for students to test their math skills and get interested in problem solving and analytical thinking. For advanced students who wish to move on to the next levels of competitions in competitions, the CMS is ready, this year like any other year, to offer them further opportunities and help them qualify for 2020 Team Math Canada. The 2019 Math Team Canada made us proud this year, winning six medals in this challenging international competition among 600 talented high school students from around the world. Many thanks to these brilliant students and to their leader, Matthew Brennan, for their hard work.

Other than educational programs for high school students, the CMS has been working hard to offer more programs to researchers and academic members. We have several new additions to CMS semi-annual meetings. In order to add more value to CMS meetings and make them more attractive for students and researchers, as of summer 2019, the CMS has been organising three-hour mini-courses. This initiative was very well received this summer at the Regina meeting and there are already 10 mini-courses in diverse areas of Mathematics lined up for the CMS Winter Meeting in

Toronto. Moreover, with the help of the Scientific Directors and taking advantage of local expertise, the scientific sessions in the CMS Meetings now cover a wide variety of topics including pure and applied mathematics, probability, mathematical finance, biostatistics, epidemiology, and other hot topics in mathematics. In order to support young parents, especially young female scientists, the CMS took the initiative to include childcare arrangements at the earliest possible stage of meeting planning as of 2019. This service was freely available in the Summer 2019 Meeting and will also be available to all the participants and will be free of charge for all CMS members in Winter 2019 Meeting. This was made possible, at the 2019 Summer Meeting, through the support of the University of Regina, and the CMS can continue the initiative for the 2019 Winter Meeting with the support of the University of Waterloo, University of Toronto at Scarborough, University of McMaster and Dr. Mavriplis (the NSERC Chair for Women in STEM) for the Winter 2019 meeting. In addition to a Women and Diversity Luncheon at the CMS Winter meeting this December there will also be an LGBTQ+ luncheon; thanks to Robin Gaudreau and Ryan Gibara for organising it and to oSTEM for sponsoring the event. I hope this will be the first of many other LGBTQ+ STEM events to come for the CMS.

To further expand, the CMS Meetings program, the CMS and Mitacs will be launching the Mitacs Innovation Lecture series in December 2020 in conjunction with the CMS 2020 Winter Meeting in Montreal. The Mitacs Innovation Lectures will illuminate the mathematical underpinnings of significant innovative developments that impact our world.

The CMS also has some exciting news regarding our virtual activities. Thanks to Steve Laroque, the CMS is hoping to launch a new user-friendly website in 2020. Moreover, as part of the CMS' efforts to be greener, starting January the CMS Notes will only be available online.

All these additions and achievements will not have been possible without the support and donations of our members and our sponsors. This year too, the CMS is launching a fundraising campaign in December asking members to help CMS continue its operations and better represent the mathematical community and your visions. We hope that you support the CMS, as always, with your generosity.

In 2019, I took over the reins from Dr. Graham Wright, a dedicated supporter and former Executive Director of CMS for almost over 30 years. Mathematically speaking 2019 is not a prime number – it can be evenly divided by 3 and 673; however, 2019 has been a prime year for me and for the CMS. I owe this success primarily to Dr. Graham Wright and Dr. Mark Lewis for their help, support and advice. Many thanks to the CMS Executive and Board of Directors and all the members of the society who helped me through my first year with their great comments and advice. Last but far from least, I would like to thank the CMS staff Alan, Denise, Gosia, Sarah, Yvette and Zishad for all their dedications and great work at the CMS.

Suite de la couverture

les années à venir. Nous tenons à remercier notamment Professeure Dorette Pronk, la chef de l'équipe canadienne d'OEMF, et les autres partenaires et bénévoles qui ont prêté leurs soutiens à ces jeunes mathématiciennes talentueuses.

Au niveau national, les camps mathématiques de la SMC sont en croissance. La SMC est fière d'avoir établi au moins un camp dans chaque province canadienne, plusieurs dans certaines, servant ainsi les élèves de tous les milieux. En 2019, avec le soutien du programme Promoscience et de la Fondation RBC, la SMC a pu organiser, *pour la première fois dans l'histoire de la Société*, un camp mathématique pour les communautés du Nord et les élèves autochtones au Yukon. Grâce particulièrement au Professeur Joseph Khoury (président du comité d'éducation) et à Dana Mills (la coordinatrice de proximité jeunesse en STIM au Collège du Yukon), ce camp a été un grand succès. La SMC compte aussi organiser deux nouveaux camps en 2020, l'un au Yukon et l'autre aux Territoires du Nord-Ouest.

Un autre objectif de la SMC est de rendre les documents et le matériel éducatifs accessibles à un plus grand nombre d'élèves. Avec le soutien de la Fondation Intact, la SMC a pu rendre la revue prestigieuse de résolution de problèmes, *Crux Mathematicorum* (CRUX), accessible à tous et à toutes en ligne à partir du janvier 2019. Ainsi, les enseignant.e.s en mathématiques à l'intérieur et l'extérieur du Canada peuvent compter sur CRUX comme une ressource gratuite d'enseignement. Merci notamment à Professeure Knesiya Garaschuk de l'Université de Fraser Valley pour son travail extraordinaire et son dévouement à cette revue. La revue pourrait également servir les enseignant.e.s à préparer leurs élèves pour les concours de la SMC, dont le DOCM.

En 2018, un nombre record d'élèves du Canada et du monde ont écrit le Défi ouvert canadien de mathématiques (DOCM). Afin d'augmenter davantage le taux de participation d'élèves de tous les niveaux mathématiques et d'avoir un plus grand et plus divers bassin d'élèves pour l'Équipe mathématique du Canada, la SMC a envoyé des invitations aux directeurs et directrices ou aux enseignant.e.s en mathématiques des écoles secondaires les invitant à participer à ce prestigieux concours national. Ces concours offrent aux élèves une manière interactive et amusante de mettre leurs compétences mathématiques à l'épreuve et de s'intéresser à la résolution de problèmes et à la pensée analytique. Pour les élèves qui souhaitent avancer aux prochains concours, la SMC offre d'autres occasions pour les aider à qualifier pour l'Équipe mathématique du Canada en 2020. La Société est d'ailleurs très fière de l'Équipe mathématique du Canada de 2019 qui est rentrée du Royaume-Uni avec six médailles parmi les 600 concurrent.e.s talentueux.ses de tous les coins du monde. Nous tenons à remercier ces élèves fort brillants et leur chef d'équipe, Matthew Brennan, pour leur travail exceptionnel.

En plus des activités pédagogiques pour les élèves du secondaires, la SMC travaille fort pour offrir des programmes taillés pour les chercheur.e.s et les membres universitaires. Cette année, la Société a ajouté de nouvelles initiatives aux Réunions semi-annuelles. Compter de l'été 2019, afin d'ajouter à la valeur de ces réunions et de les rendre plus pertinentes pour les étudiant.e.s et les chercheur.e.s, la

SMC organise des mini-cours de trois heures. Cette initiative a été reçue avec beaucoup d'enthousiasme cet été à Regina and il y a à date dix mini-cours prévus pour la Réunion d'hiver 2019 à Toronto, portant sur de multiples sujets mathématiques. Qui de plus, avec l'aide des directeurs et directrices scientifiques, et profitant de l'expertise local, les sessions scientifiques de la Réunion d'hiver abordent maintenant un large éventail de sujets y compris les mathématiques pures et appliquées, les finances mathématiques, la biostatistique, l'épidémiologie et d'autres sujets brûlants. De surcroît, pour mieux soutenir les jeunes parents et, surtout, les mathématiciennes, la SMC a décidé d'offrir le service de garde d'enfants lors des réunions et de l'inclure dans les étapes préliminaires de planification de Réunions. Ce service sera gratuit pour les membres de la SMC lors de la Réunion d'hiver. La SMC a pu offrir la garde d'enfants en été 2019 grâce au soutien de l'Université de Regina et c'est avec le soutien de l'Université de Waterloo, de l'Université de Toronto à Scarborough, de l'Université McMaster et de Catherine Mavriplis (titulaire de la Chaire pour les femmes en sciences et en génie du CRSNG) que le programme puisse s'offrir en hiver 2019. En plus d'un dîner-causerie sur l'égalité et la diversité en mathématiques à la Réunion de l'hiver 2019, il y aura aussi un dîner-causerie LGBTQ+, grâce aux efforts de Robin Gaudreau et Ryan Gibara et au soutien de oSTEM. J'espère que cet événement annonce l'avènement d'autres programmes LGBTQ+ à la SMC.

De plus, à partir de décembre 2020 et en concert avec la Réunion d'hiver de la SMC 2020 à Montréal, la SMC lancera une série de conférences sur l'innovation par Mitacs. Les conférences de Mitacs illumineront les fondements mathématiques de développements innovateurs importants qui ont un impact dans notre monde.

La SMC est aussi heureuse d'annoncer de nouvelles activités virtuelles. Grâce à Steve Laroque, la SMC lance un nouveau site web avec une interface conviviale en 2020. De surcroît, dans le cadre de nos efforts d'être plus écologiques, à partir de janvier 2020, les Notes de la SMC seront seulement disponibles en ligne.

Ces programmes et accomplissements n'auraient pas été possibles sans le soutien et les dons de nos membres et de nos partenaires. Cette année aussi, la SMC lance une campagne de collecte de fonds en décembre encourageant nos membres à aider la SMC à continuer ses activités et à mieux représenter la communauté mathématique et ses visions. J'espère que vous continuerez à offrir vos généreux soutiens à la Société.

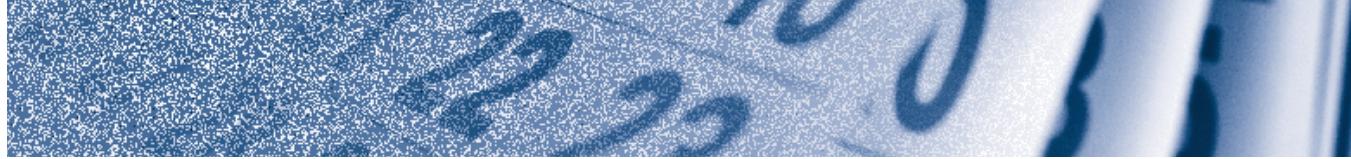
En 2019, j'ai pris la relève du M. Graham Wright, l'ancien Directeur général de la SMC et un membre loyal pour près de 30 ans. En termes mathématiques, 2019 n'est pas un nombre premier – il est divisible par 3 et 673; or 2019 a été une année singulière, et, en un sens, première, pour moi et pour la SMC. Je dois ce succès avant tout à Graham Wright et à Mark Lewis pour leur aide, leur soutien et leur conseil. Remerciements particuliers au comité exécutif et au conseil d'administration et à tous les membres de la Société qui m'ont aidé avec leurs conseils et leurs commentaires. Finalement, je tiens à remercier les membres du personnel, Alan, Denise, Gosia, Sarah, Yvette et Zishad pour leur dévouement et leur travail exceptionnel à la SMC.

The Calendar brings current and upcoming domestic and select international mathematical sciences and education events to the attention of the CMS readership. Comments, suggestions, and submissions are welcome.

Denise Charron, Canadian Mathematical Society,
(mpagent@cms.math.ca)

Le calendrier annonce au lectorat de la SMC les activités en cours et à venir, sur la scène pancanadienne et internationale, dans les domaines des mathématiques et de l'enseignement des mathématiques. Vos commentaires, suggestions et propositions sont les bienvenues.

Denise Charron, Société mathématique du canada,
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DECEMBER 2019 DÉCEMBRE

1-6	Challenges in Mathematical and Computational Modeling of Complex Systems, BIRS, Banff, AB
6-9	2019 CMS Winter Meeting / Réunion d'hiver de la SMC 2019, Chelsea Hotel, Toronto, ON
8-13	Discrete Subgroups of Lie Groups, BIRS, Banff, AB
24-Jan 2	CMS Office closed / Le bureau de la SMC est fermé.

JANUARY 2020 JANVIER

10	Workshop on Smart Cities Analytics, Fields Institute, Toronto, ON
12-17	Mathematical Modelling in Glaciology, BIRS, Banff, AB
13-17	Winter Graduate School in Toric Topology, Fields Institute, Toronto, ON
15-18	AMS/MAA Joint Mathematics Meeting 2020, Denver, CO, USA
17	Colloque des sciences mathématiques du Québec: Dimitris Koukoulopoulos, McGill University, Montréal, QC
19-24	Proof Complexity, BIRS, Banff, AB
20-24	Workshop on Polyhedral Products in Homotopy Theory, Fields Institute, Toronto, ON
24-26	2020 Combinatorial Algebra Meets Algebraic Combinatorics, Dalhousie University, Halifax, NS
26-31	Fracitons and Beyond, BIRS, Banff, AB

FEBRUARY 2020 FÉVRIER

2-7	Dynamics in Geometric Dispersive Equations and the Effects of Trapping, Scattering and Weak Turbulence, BIRS, Banff, AB
9-14	Geometric Tomography, BIRS, Banff, AB
16-21	Advances in Theoretical and Experimental Methods for Analyzing Complex Regulatory Networks, BIRS, Banff, AB
18-19	Voting Systems, CRM, Montreal, QC
23-28	Use of Wearable and Implantable Devices in Health Research, BIRS, Banff, AB
24-Mar 13	Open Quantum Systems Course, African Institute for the Mathematical Sciences, Limbe, Cameroon (supported by AARMS)

MARCH 2020 MARS

1-6	Equivariant Stable Homotopy Theory and p-adic Hodge Theory, BIRS, Banff, AB
8-13	The Interface Between Selective Inference and Machine Learning, BIRS, Banff, AB
14	International Day of Mathematics
15-20	New Perspectives in Colouring and Structure, BIRS, Banff, AB
22-27	Stochastic Mass Transports, BIRS, Banff, AB
23-27	Workshop on Torus Actions in Topology, Fields Institute, Toronto, ON
23-27	Optimization under uncertainty, CRM, Montreal, QC
27-29	Creating Authentic Experiences in Mathematics Courses, BIRS, Banff, AB
29-Apr 3	New Directions in Geometric Flows, BIRS, Banff, AB

Book Reviews brings 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)

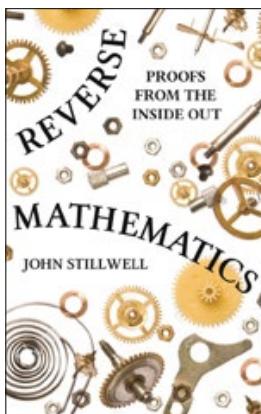
Reverse Mathematics: Proofs from the Inside Out

by John Stillwell

Princeton University Press, 2018.

ISBN: 978-0-69117-717-5

Reviewed by Barbara Csima, University of Waterloo



to the basics of Reverse Mathematics, and perhaps be suitable for our “Learning Seminar” with graduate students. I apparently quite misunderstood what was meant by “a general mathematical audience”. This is not a book for graduate students in mathematics. However, it could be a nice holiday gift for their parents.

Through exploring the topic of Reverse Mathematics, Stillwell’s book hits topics of common interest for general mathematics enthusiasts: Logic and foundations, as well as classical geometry, number theory, and analysis. Stillwell begins his explanation of proofs, axioms, and truths that cannot be proved from axioms, through an investigation of geometry. He explains how non-Euclidean geometry shows that the parallel axiom does not follow from the basic axioms of Euclid, but that various equivalent formulations of the parallel axiom can be shown to be equivalent using only the basic axioms. This is how he sets up the notion of a weak “base system” of axioms, over which other theorems or axioms can be shown to be equivalent.

Before discussing the reverse mathematical strength of various mathematical theorems, Stillwell first describes how we may even state these theorems by showing how to arithmetize mathematics, that is, how to get from the natural numbers to the rational, real and complex numbers, and continuous functions. Once able to state them, Stillwell gently reviews proofs of major theorems of analysis, such as the Intermediate Value Theorem, Extreme

Les comptes-rendus de livres présentent au lectorat de la SMC des ouvrages intéressants sur les mathématiques et l’enseignement des mathématiques dans un large éventail de domaines et sous-domaines. Vos commentaires, suggestions et propositions sont les bienvenues.

Karl Dilcher, Dalhousie University (notes-critiques@smc.math.ca)

Value Theorem, Bolzano-Weierstrass Theorem, and Heine-Borel Theorem. He gives a construction of the Cantor Set as an important segue to the relationship between these concepts of analysis and (infinite) binary branching trees. Normally when general logic texts touch on Computability Theory, they go only as far as the Halting Set (an example of a computably enumerable set that is not itself computable). Stillwell goes a bit further, developing just enough Computability Theory to be able to make sense of “there is an infinite, computable, binary branching tree with no infinite computable path”. This is interesting because König’s Lemma tells us that infinite paths must exist, so this gives a natural example of the possibility of non-computable sets showing up in a different setting than the Halting Set. Stillwell then goes on to explain how concepts from Computability Theory can be coded into formal logical statements about number theory (fans of the incompleteness theorems will enjoy this).

With the stage set, Stillwell finally, more than midway through his book, is ready to define the weak base system over which most of modern Reverse Mathematics takes place: RCA0. I don’t want to try to define it. Roughly speaking, RCA0 is the “land of the computable”. If something can be described computably, relative to what is going on, then RCA0 can prove it. Stillwell next defines ACA0, where the simplest model has witnesses for halting sets relative to any set that appears. That is, ACA0 is powerful enough to prove existence of sets definable by formulas with finitely many alternating variable quantifiers, but no set quantifiers. He discusses the equivalence of ACA0 to many theorems of analysis, such as the Sequential Bolzano-Weierstrass theorem and the Sequential least upper bound principle.

In the penultimate chapter, Stillwell focuses on relationships relative to the base system, that is, on explaining why various equivalences are actually provable in RCA0. He formally introduces the system WKLO, that adds “every infinite binary branching tree has an infinite path” to RCA0. This seemingly strange axiom group turns out to be exactly the strength needed for the Sequential Heine-Borel Theorem and the Extreme Value Theorem, among others. Things move quickly in this chapter, and the reader is often instructed to glance back at earlier proofs to see that they in fact work in RCA0. Frequent appeal is made to the intuition of noticing that certain constructions are computable relative to others, and it is much less formal than arguments earlier in the book. Nonetheless, the book neatly places the various theorems into their axiom groups, or “orbits”. Stillwell ends the chapter by quickly motivating two more axioms groups, rounding out the “big five” axiom groups to which “most” theorems belong.

The final chapter is called “A Bigger Picture”, and I was a bit disappointed with this chapter. I thought it would be the place to at least hint at what research has been going on in the active field of Reverse Mathematics in the last 15-20 years. Indeed, the very last section almost implies that all theorems can be linearly ordered by their strength, and we need just find for each their right spot. Earlier in the text, it is only in passing mentioned that there are theorems known to outside the “big five”, and nowhere did I notice it mentioned that ordering with respect to reverse mathematical strength is in general a complex partial ordering. I believe that, given the publication date of the book, it is a serious omission not to mention this complexity, and the limitations of the standard Reverse Mathematics approach in certain settings.

Overall, I enjoyed reading this book, though I was confused about the intended audience. In some parts it dwells on subtleties, while in others ignores them without comment (likely to keep the general audience on board). Its slow pace and lack of comment on the current state of the field make it difficult to view it as a mathematician’s introduction to Reverse Mathematics. On the other hand, for someone who once dabbled in mathematics, enjoyed it but didn’t pursue it, and wants to read something other than the latest Grisham, this book might be just for them.

Convex Functions and Their Applications (2nd Edition)

by Constantin P. Niculescu and Lars-Erik Persson

CMS Books in Mathematics, Springer, 2018

ISBN: 978-3-319-78336-9.

Reviewed by Heinz Bauschke, UBC Okanagan



Convex objects, be it sets or functions, have attracted the attention of mathematicians for centuries. Convex Analysis and Convex Optimization continue to be popular areas of mathematics due to their striking combination of beauty and utility.

Niculescu and Persson’s book *Convex Functions and Their Applications*, now in its substantially revised second edition, aims to be “a thorough introduction to contemporary convex function theory.” This 415-page book is organized in 7 chapters and 5 appendices. Each chapter contains numerous exercises and extensive concluding comments. The authors include various results from their own research, many of which appearing for the first time in book form. The bibliography is comprehensive and up-to-date, containing (exactly!) 500 references. A brief overview of the book follows.

Chapter 1 is foundational and covers convex functions defined on intervals. The material is mostly classical and includes Young’s and Jensen’s inequalities, log-convexity, (sub)differentiability and absolute continuity, Abel’s partial summation formula and consequences, and the Hermite-Hadamard inequality.

The transition from the real line to real linear vector spaces is initiated in Chapter 2. Results on projection operators and separation theorems are to be found here along with a careful introduction to the space of real symmetric matrices which has been of central importance in applications of convex optimization to statistics and control theory.

The third chapter deals with convex functions defined on a normed linear space, with particular emphasis on various (sub)differentiability properties. Also discussed are perspective functions, log-concavity (via the Prékopa-Leindler inequality), and volume inequalities from the theory of convex bodies.

Chapter 4 explores connections between convexity and classical majorization theory. The authors survey the Schur-Horn theorem, Schur convexity, eigenvalue inequalities, and hyperbolic polynomials.

The study of convexity on matrix spaces is deepened in Chapter 5 where the authors further investigate spectral functions, matrix convexity, and the hyperbolic geometry in the space of real symmetric matrices.

The sixth chapter develops the (dual) Fenchel conjugate, the associate conjugate calculus, and duality for convex optimization problems. Also discussed are minimax theorems, Moreau-Yosida approximations and the Hopf-Lax formula.

The final Chapter 7 focuses on further results related to majorization including Steffensen-Popoviciu measures, Choquet’s theorem and the Hermite-Hadamard inequality for signed measure.

The appendices nicely complement the chapters by offering additional content, including material on generalized convexity, elementary symmetric functions and associated inequalities, Alexandrov’s Theorem, and elliptic boundary value problems.

I particularly enjoyed the detailed comments at the end of each chapter. These range from historical remarks and references to related current research directions to which the authors often contributed. Returning to the authors’ aim to provide a thorough introduction to contemporary convex function theory, I believe they succeeded admirably. The book can serve well as reference text for graduate students and researchers in Convex Analysis. Indeed, researchers will be richly rewarded by discovering beautiful and useful results. I have placed this book next to my trusted copies of Rockafellar’s *Convex Analysis*, Zalinescu’s *Convex Analysis in General Vector Spaces*, and Borwein and Vanderwerff’s *Convex Functions*. I am confident that anyone interested in Convex Analysis will be delighted and inspired by this beautiful book by Niculescu and Persson.

BRIEF REVIEW

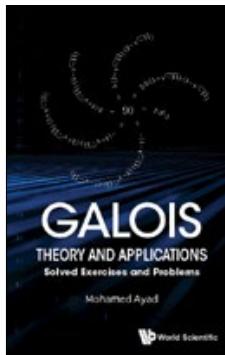
**Galois Theory and Applications:
Solved Exercises and Problems**

by Mohamed Ayad

World Scientific

ISBN 978-981-3238-30-5

Reviewed by Keith Johnson, Dalhousie University

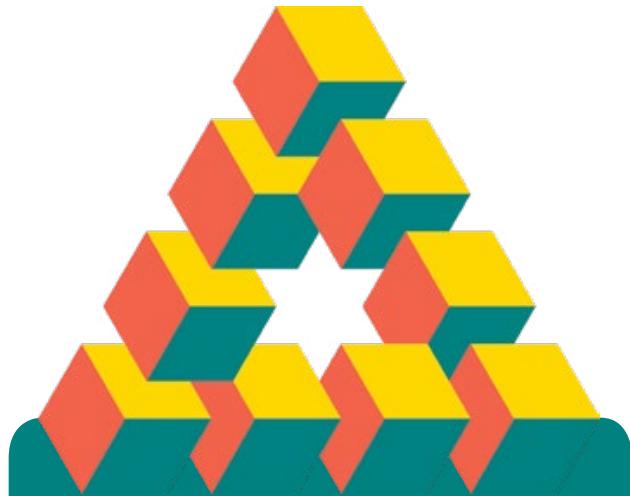


Problem collections play a special role in mathematics, giving a way to sharpen your skills and test your knowledge in a familiar field or as a basis for self-study in a new one. Indeed, one school of mathematical pedagogy, the Moore method, maintains that the latter provides the best way of training mathematicians.

The book under review is an excellent representative of this class, although

its title somewhat understates the range of topics covered and doesn't indicate the sophistication of most of the problems. In addition to the expected sets of problems about fields, extensions and automorphism groups there are chapters of problems about permutation polynomials (polynomials acting as permutations on finite fields) and multivariable polynomials and an extended chapter (over 100 pages) of problems in algebraic number theory.

You won't find many routine problems here to use as exercises in an undergraduate algebra class. However, good honours students, graduate students preparing for comprehensive exams, and professional algebraists will find this book invaluable.

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Education Notes brings mathematical and educational ideas forth to the CMS readership in a manner that promotes discussion of relevant topics including research, activities, and noteworthy news items. Comments, suggestions, and submissions are welcome.

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Les Notes pédagogiques présentent des sujets mathématiques et des articles sur l'éducation aux lecteurs de la SMC dans un format qui favorise les discussions sur différents thèmes, dont la recherche, les activités et les nouvelles d'intérêt. Vos commentaires, suggestions et propositions sont les bienvenues.

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Supplementary Mathematics/ Physics Sessions for Undergraduate Physics Students

Andie Burazin, University of Toronto
Mississauga, Robert Gillespie Academic Skills
Centre and Department of Mathematical and
Computational Sciences

Marc De Benedetti, University of Toronto
Mississauga, Department of Chemical and
Physical Sciences

A well-known recurring issue for first- and second-year physics students arises when required mathematical concepts within the physics courses are encountered prior to having been taught in the corresponding mathematics courses. The earliest such instance typically involves incoming first-year students with basic knowledge about derivatives from high school calculus. Within the first few weeks of a course in physics, integration – often not covered in high school, and taught only in the second half of a first-year calculus course – is needed to discuss physics applications. A similar curricular gap also affects second-year physics students.

The root of the issue is that advanced mathematics is needed to understand, interpret, and solve physics problems, and thus the physics courses cannot simply be modified to avoid using these advanced concepts. Physics course instructors do present a superficial introduction to the required mathematics concepts within their lectures, but are unable to devote adequate amount of time to them.

To assist physics students with these curriculum gaps, the authors developed an initiative to facilitate the learning of mathematical concepts and ideas required in physics courses through supplementary support sessions. This article describes the genesis of the supplementary mathematics and physics support sessions along with their efficacy, challenges, and anticipated future growth.

Workshop-style Supplementary Sessions: Genesis and Details

During the 2017-2018 academic year in the Department of Chemistry and Physical Sciences at the University of Toronto Mississauga, the Numeracy Specialist at the Robert Gillespie Academic Skills Centre developed two one-hour mathematics sessions to enrich the students' background. The sessions covered integration (normally taught in the winter term in first-year calculus courses) and basic linear algebra (working with vectors and their properties). They were delivered outside of the regularly scheduled course meetings and consisted of a mini lesson followed by group-work exercises. As well, a two-hour final exam review was offered to students at the end of the term, focusing solely on the new mathematics concepts. Although attendance was optional, approximately half of the 65 students in the class regularly attended. A diagnostic feedback questionnaire was administered to all attending students. Approximately 75% of the respondents felt that the sessions helped them to learn the required mathematics, thus enabling better understanding of the physics material. A few students also suggested that such sessions might be beneficial for subsequent physics courses. The overall results of the survey were positive, and an official pilot project was created to offer similar support in the second (subsequent) first-year physics course in the winter 2018 term.

This second half of the first-year physics course requires knowledge of surface integrals and partial derivatives, as well as facility with setting up and interpreting solutions of ordinary differential equations – a considerable step up from the mathematics used in the first-half (prerequisite) physics course. The pilot project was designed to formally integrate mathematics and physics support, by offering two one-hour supplementary sessions per week for eight weeks (out of a twelve-week term), which followed the course content. Each week, the two weekly sessions introduced (lecture-style) the mathematics or physics concepts, followed by students collaboratively working on exercises and problems. Again, all sessions were optional with no graded assessments and no credit given. The first session was scheduled in the first half of the week and focused on the necessary mathematical techniques and calculations. The second session, scheduled toward the end of the week, tied the mathematics to the physics applications discussed in the course.

Efficacy and Student Feedback

To assess the efficacy of the pilot project, a feedback questionnaire was administered. Among the students who completed the questionnaire, the consensus was that the sessions gave them more confidence in working with the physics course's material. Approximately 70% strongly agreed with the statement that the supplementary mathematics and physics sessions helped them better understand the mathematics involved. Another important outcome was that the students expressed interest in having these sessions extended to second-year physics courses.

Given the positive feedback both from the questionnaire and the course instructors, as well as the students' continual need for support, the sessions were expanded to include two second-year physics courses (Electromagnetism and Vibrations & Waves) in the 2018-2019 academic year. These courses require the use of multivariable calculus, vector calculus, complex variables, and differential equations – concepts taught much later in mathematics courses. A total of five mathematics and physics sessions were created and designed to align with the course material. The objective was to present difficult concepts before or shortly after lectures so that students were familiar with ideas as discussed in lecture.

An illustrative example was covering the surface integral that was needed in Electromagnetism, including the notion of a multi-variable function, double integrals, the meaning of the infinitesimal area element dA , and computing the vector dot products with dA . These new mathematical tools were then applied to the surface integrals in the corresponding physics session – focusing on applications such as Gauss's Law, Gaussian surfaces, common assumptions that are made when using Gauss's Law, and the notion of how all the physics in Gauss's Law occurs within the element of area dA . All these concepts require careful attention, and present considerable teaching challenges when constrained to the allotted pair of one-hour sessions (i.e., it is a challenge to effectively present all this material in a total of two hours). The time constraint is a limitation to be addressed in future iterations, along with the need for additional funds and resources.

For both second-year physics courses, on average 35% of the class of 50 students attended our sessions regularly. Those who attended felt more confident in handling physics questions that required advanced mathematical topics. Test and quiz marks of students who attended the supplementary instructional sessions showed an improvement with marks ranging from a minimum of 5% to a maximum of 10% higher than the class mean. Although the exact cause and effect are difficult to pinpoint, the correlation between attendance and performance is striking. One may argue this is a result of selection bias - that the group of students who voluntarily sought extra help were either slightly stronger and/or had better studying habits, but perhaps the investment in the sessions by the organizers made the difference in student performance. Presently, the authors are working with the university to make the attendance for these sessions mandatory. This will not only help determine cause(s) for the grade increase, but also provide uniform support

for all students in the course. Similar initiatives could be – and will be – created in other disciplines where students might struggle with mathematics. In the fall 2019 term, support sessions will be created for a second-year statistics course (Probability and Statistics) in the Department of Mathematical and Computational Science through the Robert Gillespie Academic Skills Centre. For instance, when working with probability distributions, many students struggle to identify the appropriate two- or three-dimensional region involved in multiple integration, which is a topic in the calculus of several variables.

Things to Keep in Mind When Planning Sessions

The authors encourage their colleagues and others from different institutions to consider offering such supplementary support sessions outside of a course in any discipline. For those interested, these sessions can be organized by hiring, and adequately preparing, additional graduate student TAs or sessional faculty through the institution's academic skills centre, the mathematics department, or their own disciplinary department. It is important to have individuals who know both the mathematics material covered in the sessions as well as the corresponding interdisciplinary content, if present. The goal of this initiative, which assists in bridging the gap in background knowledge or provides more exposure to challenging concepts and ideas, is to better prepare students for first- and second-year undergraduate courses.

For those who wish to pursue a similar initiative, the authors would like to share a couple of things, based on their own experience. First, a healthy relationship between the course instructor(s) and those who run the sessions is needed. Having a course instructor to participate in designing sessions is an extra task for them, on top of running the actual course. However, that task can be minimized: a course instructor can pinpoint the area(s) of difficulty that can be discussed and clarified in the sessions, for instance when there is not enough time in a lecture to do a thorough review of necessary background material. As well, they can motivate their students during class time to attend the sessions, by announcing that they will have a chance for further discussion and for working on additional relevant examples and exercises. Second, the supplementary mathematics and physics sessions did not benefit all students, in part due to the scheduling. The optional sessions were organized outside of the regular scheduled class time and left for the students to attend. We suggest to incorporate the sessions within the official course contact time, as a mandatory component. If that is not possible, additional help needs to be readily accessible to those students who need it, but were unable to attend the sessions.

For further details and questions about the Supplementary Mathematics/Physics Sessions for Undergraduate Physics Students, please contact directly Andie Burazin (a.burazin@utoronto.ca) and/or Marc De Benedetti (marc.debenedetti@mail.utoronto.ca)

More information about student and faculty support that the Robert Gillespie Academic Skills Centre offers can be found at this link: <https://www.utm.utoronto.ca/asc/our-mission>

CSHPM Notes brings scholarly work on the history and philosophy of mathematics to the broader mathematics community. Authors are members of the Canadian Society for History and Philosophy of Mathematics (CSHPM). Comments and suggestions are welcome; they may be directed to either of the column's co-editors:

Amy Ackerberg-Hastings, Independent Scholar

(aackerbe@verizon.net)

or

Hardy Grant, York University [retired] (hardygrant@yahoo.com)

On the Path to Community: Experiencing a Summer Math Camp

Glen Van Brummelen, Quest University

It's 8:30 AM, and you have to deliver a lecture on your mathematical specialty to a group of 110 students. When you enter the lecture hall, it's empty; you set up the projector and the microphone in the early morning quiet. Suddenly a boisterous group of ten students enters from the back of the room, eagerly chatting with each other, some of them glancing furtively at the screen to see if they can get a hint of the morsels you've prepared. Then another ten, and another ten, arriving in groups from breakfast at the cafeteria, until all are present. The room is buzzing, but quickly quietens as you are presented to them. As you begin, all faces are concentrated. Some are taking notes. A few minutes in, you ask your first question. Twenty hands shoot up, and you can't decide whom to pick. The perceptive response propels you forward. Hands continue to go up, every dozen seconds or so. Eventually you relent and call on one student. Her question causes you to pause. You've never thought about the theorem in quite that way before. It opens up possibilities. You express your appreciation for her comment, and start to develop it. She is eleven years old.

Les articles de la SCHPM présentent des travaux de recherche en histoire et en philosophie des mathématiques à la communauté mathématique élargie. Les auteur.e.s sont membres de la Société canadienne d'histoire et de philosophie des mathématiques (SCHPM). Vos commentaires et suggestions sont les bienvenues et peuvent être adressées à:

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(aackerbe@verizon.net)

ou

Hardy Grant, York University [retraité] (hardygrant@yahoo.com)

This scenario—a professor's fantasy!—plays out every day in July on a university campus in the USA, at the summer camp MathPath. Brought together from across North America and a few other nations, these children ages 11 to 14 have had to pass an entrance test that most of your undergraduate students would struggle with. You might not care to try it, for fear of being shown up by a middle schooler. They are some of the brightest kids in the world. At home, their talents isolate them. They struggle with loneliness while being praised for being exceptional. MathPath brings them together, reassuring them that they are not freaks of nature, and it's OK to be excited about Ramsey theory or non-Euclidean geometry when they return home. There are others like them, friends and companions on the mathematical journey.

MathPath is one of several related camps founded by George Thomas, starting in the 1990s in Vancouver. Mathcamp is for older children, Epsilon and Delta camps for younger. A sister camp to MathPath was opened in China last year. Several other camps on mathematics and related disciplines have similar goals, and all promote both the intellectual and social development of students who often sit by themselves at the top of their class at home. Each camp does enormous good, and it is a credit to the CMS and other related societies that they support the camps financially.

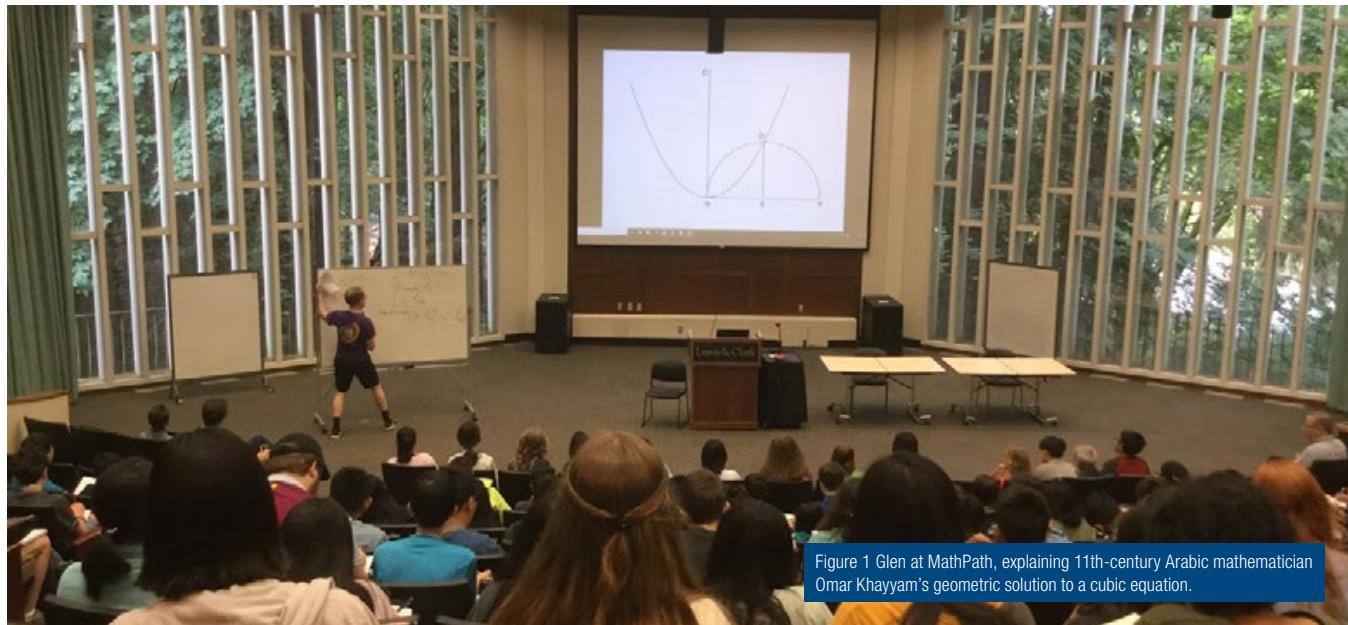


Figure 1 Glen at MathPath, explaining 11th-century Arabic mathematician Omar Khayyam's geometric solution to a cubic equation.

MathPath's niche in the list of camps for its age group is breadth. Its belief is that students at this age level do not need to be accelerated along the traditional subjects more quickly than is already happening. Rather, the mathematical experience is broad enough that there are many pathways off to the side of their school curriculum. There are courses in training for mathematics competitions, but they are not the central focus. Students experience graph theory, hyperbolic geometry, cryptology, number theory, combinatorics, complex analysis, and even spherical trigonometry (yes, that's mine). These side routes give students a much fuller notion of what mathematics is, and the diversity of worlds there are to explore.

I have been teaching the history of mathematics at MathPath since its first year in 2002, pulled back annually by the powerful teaching environment, amazing staff, and especially the incredible, unique, and yet refreshingly normal kids who interrupt me at lunch to ask math questions or to have me draw them a Glensheep (that's a long story). In 2005 I was giving my first class, and a kid who hadn't yet learned social graces called out repeatedly: "Why do I have to sit through this? This is history, not *math*!" I spent that evening crafting a response, which he deserved, and it has been my first lecture to the kids ever since. I tell them: In a way, mathematics *is* history. We learn how to solve problems by observing how others have approached them. You and I did not invent completing the square or clever methods to count collections. But problem-solving isn't enough. As mathematicians we also need to know the terrain: What subjects have been shown to be powerful? What direction has a particular subcommunity been heading? What were the motives for giving birth to $\sqrt{-1}$, and how can we press ideas like it further? How have other groups and cultures thought differently about the same concepts, and how can we break with our traditions in ways that are fruitful? That kid must be 25 years old now. Wherever you

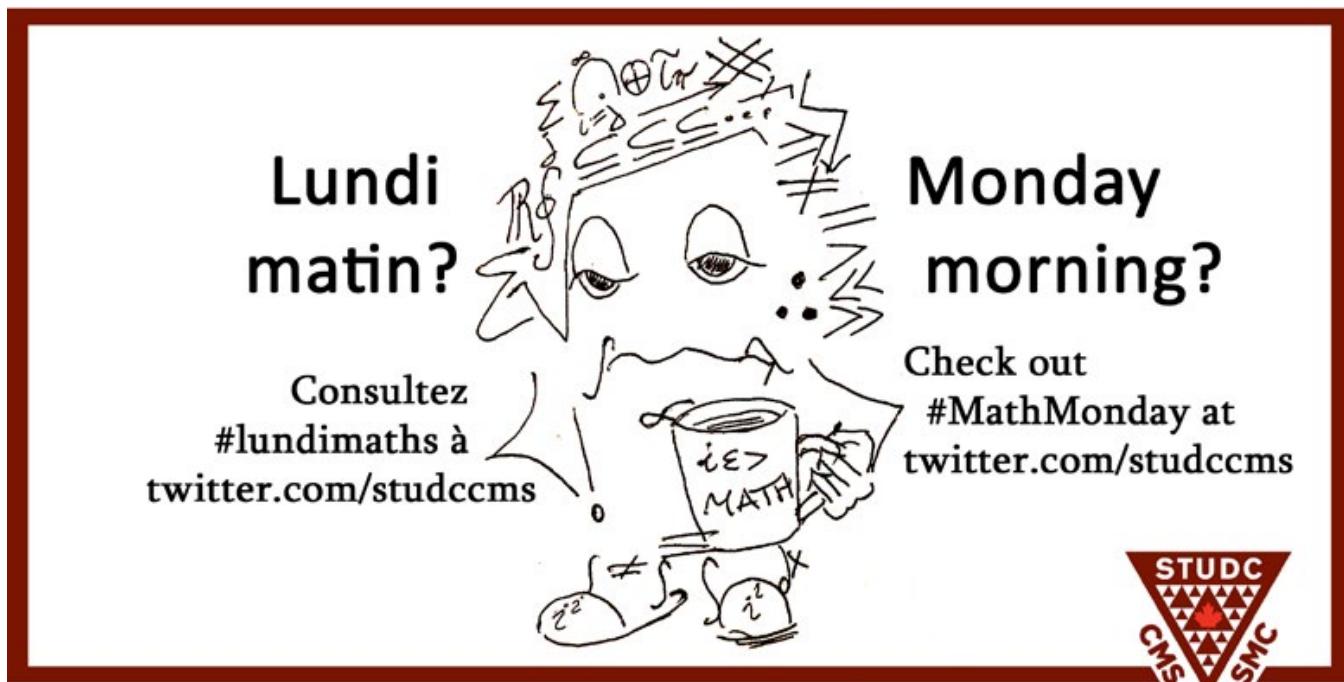
are now, thank you. You helped me to explain more clearly why history is important to someone interested only in mathematics.

For many years I have taught the mathematics of various pre-modern cultures, while Tom Drucker has put a philosophical spin on more modern mathematical developments. Other CSHPM members have also lectured at MathPath, including Janet Heine Barnett, Patti Hunter, Dominic Klyve, Amy Shell-Gellasch, and likely others to whom I apologize for my poor memory. The camp is staffed by some of the best teachers in North America, many of them national teaching-award winners and educational leaders. Since near the beginning Steven Maurer served as academic director and helped to shape MathPath's vision powerfully, alongside Kip Sumner and Al Lippert. Matt DeLong is now the academic director, and Sam Vandervelde is interim executive director. Others who have lectured at the camp include John H. Conway, Joan Hutchinson, Karen Saxe, Francis Su, Stephen Wolfram, and Paul Zeitz.

As students and their parents report back weeks or years later, camps like MathPath can be transformative experiences. Students learn new disciplines and new ways of thinking. They are exposed to the exceptional wealth of subjects and modes of thought that fit together to make mathematics. They learn, often for the first time, that it's OK to not always be the smartest kid in the room. These camps are their induction into the mathematical *community*.

If you have some flexibility this summer, consider working with one of the summer math camps. Your expectations of that 8:30 AM lecture will never be the same.

Glen Van Brummelen (gvb@questu.ca) is a historian of medieval mathematics and astronomy. He is currently on sabbatical at the Institute for Advanced Study (Princeton), researching the work of 15th-century astronomer Giovanni Bianchini.



2019 IMO Leader's Report

Matthew Brennan, MIT

The International Math Olympiad (IMO) is the world championship of high school math competitions. The Olympiad is hosted by a different country every year and each country selects up to six of its top students to take the six-question, nine-hour exam held over two days in July. This year's competition was held at the University of Bath in the United Kingdom from July 11th to 22nd and attracted 621 students from 112 countries. The Canadian team was selected based on the results of three competitions: the Asian-Pacific Math Olympiad, the Canadian Math Olympiad and the USA Math Olympiad. This year's team consisted of Thomas Guo, Howard Halim, Sebastian Jeon, Victor Rong, David Tang and William Zhao.

I was joined on the leadership side of the Canadian team by Sarah Sun and James Rickards. Our role was to organize the two-week training program for the students prior to the competition, accompany them to the competition and ensure the members of the Canadian team are properly graded during the coordination of marks after the Olympiad. James and I, as the observer and leader, also served on the IMO jury and voted to select the six problems in the week prior to the contest.

This year's training camp was held at the University of Waterloo and a joint training camp with the Mexican IMO Team. Waterloo was a phenomenal host and our students and leaders had a great time training with the Mexican team. We were joined by seven trainers from Mexico who, along with us, gave lectures to the students in the four main subjects on the IMO: algebra, number theory, combinatorics and geometry. The algebra and geometry problems on these Olympiads are not exactly what a research mathematician might expect! Olympiad algebra problems are mainly inequalities, sequence problems, functional equations and elementary problems about polynomials, while geometry encompasses Euclidean geometry problems in the plane. Combinatorics is the closest of these subjects in flavour to problems that could be found in research math. A highlight for the students was a lecture by Enrique Trevino on his research on Pell's equations and analytic properties of the sequence generated in Euclid's proof that there are infinitely many primes.



Canadian IMO Team right before the first day of the competition.

James and I left for the UK three days before the students to join the other leaders in Wales and choose the contest. We were given a shortlist of 33 problems from the four subjects to choose from. After several days of trying these problems in our room and discussing their difficulty and elegance at meetings with the other 111 leaders, the

jury arrived at the six problems to appear on the Olympiad. The first problems on the two days were a functional equation and a diophantine equation. The second problems were a difficult Euclidean geometry problem and a counting problem about a process of flips on a sequence of coins. The hardest two problems were a problem about an edge-swapping operation on graphs and an even harder Euclidean geometry problem. After the questions were set, the jury refined the official wording of the competition, translated the problems into all languages requested by the students and decided on grading schemes.

After an intense two days of the competition, the students relaxed on the University of Bath campus and enjoyed local excursions. In the meantime, Sarah, James and I graded the Canadian scripts and prepared for coordination, where we would meet with the official graders for each problem and come to an agreement on our students' deserved scores. Coordination went smoothly -- we agreed with the graders' assessment for nearly every problem. One Canadian partial solution involved a very clever idea that wasn't on the grading scheme for the problem. Sarah, James and I spent several hours in coordination discussing how many marks the partial solution was worth relative to the official solutions.

The Canadian team did very well, placing 24th overall, with everyone receiving a medal. Victor received a gold medal, Howard received silver and Thomas, Sebastian, David and William all received bronze medals. The team was a team of veterans, with four returning members and four members beginning their undergraduate studies this year. After the results were announced, we reunited with the Mexican team for a dinner in Bath before returning to Canada.



Canadian and Mexican IMO Teams at dinner after the competition.

I will leave you with the nicest problem on the contest, the third problem about an edge-swapping operation on graphs. Only 28 of the 621 contestants were able to find a complete solution.

Problem 3. A social network has 2019 users, some pairs of whom are friends. Whenever user A is friends with user B , user B is also friends with user A . Events of the following kind may happen repeatedly, one at a time:

- Three users A , B , and C such that A is friends with both B and C , but B and C are not friends, change their friendship statuses such that B and C are now friends, but A is no longer friends with B , and no longer friends with C . All other friendship statuses are unchanged.

Initially, 1010 users have 1009 friends each, and 1009 users have 1010 friends each. Prove that there exists a sequence of such events after which each user is friends with at most one other user.



An invitation to celebrate



The International Mathematical Union is leading the project of having UNESCO proclaiming March 14 (Pi Day) as the International Day of Mathematics (IDM). This proclamation has been adopted by the Executive Board of UNESCO at its 205th session in October 2018. It is now on the agenda of the 40th General Conference of UNESCO in November 2019. If adopted, the official launch will be in 2020.

Considering that March 14 2020 is a Saturday, the launch at the UNESCO Headquarters in Paris will take place on Friday March 13, 2020. We will hold a simultaneous African launch at the Next Einstein Forum in Nairobi, Kenya.

The 2020 theme is Mathematics is everywhere

- Mathematics is everywhere in science and tech.
- Mathematics is everywhere in the organization of civilizations.
- Mathematics is essential to meet the UN Sustainable Development Goals.
- Mathematics is everywhere in whatever you do.
- Tell me about an activity or area and I will tell you where mathematics is.

On the website you can

- Find open source material related to theme;
- projects, ideas, software for use in classrooms, in large events or in small activities for the children and the general public;
- Find instructions on how to organize an event;
- Post your activities on an interactive map;
- Explore the activities around the world.

How will you celebrate?

- Will you celebrate in your classroom?
- Do you wish to organize a small exhibition and/or interactive activities with your local community?
- Will your national mathematical society or mathematics teachers association organize national activities?
- Will you celebrate with a neighbouring country?

Start thinking about how you will celebrate. We are here to help. www.idm314.org



Une invitation à célébrer



L'Union mathématique internationale pilote le projet de faire proclamer par l'UNESCO le 14 mars (ou jour de Pi), la Journée internationale des mathématiques. Cette proclamation a été adoptée par le Conseil exécutif de l'UNESCO lors de sa 205^e séance en octobre 2018. Elle est à l'ordre du jour de la 40^e conférence générale de l'UNESCO en novembre 2019. Si adoptée, le lancement officiel sera en 2020.

Au vu du fait que le 14 mars 2020 est un samedi, le lancement au quartier général de l'UNESCO à Paris aura lieu le vendredi 13 mars 2020. Nous tiendrons un lancement parallèle au prochain Next Einstein Forum à Nairobi au Kenya.

Le thème 2020 est Les mathématiques sont partout

- Les mathématiques sont partout en sciences et en technologie.
- Les mathématiques sont partout dans l'organisation de la civilisation.
- Les mathématiques sont essentielles à l'atteinte des objectifs de développement durable des Nations Unies.
- Les mathématiques sont partout dans tout ce que vous faites.
- Donnez-moi une activité ou un domaine et je vous dirai où sont les mathématiques.

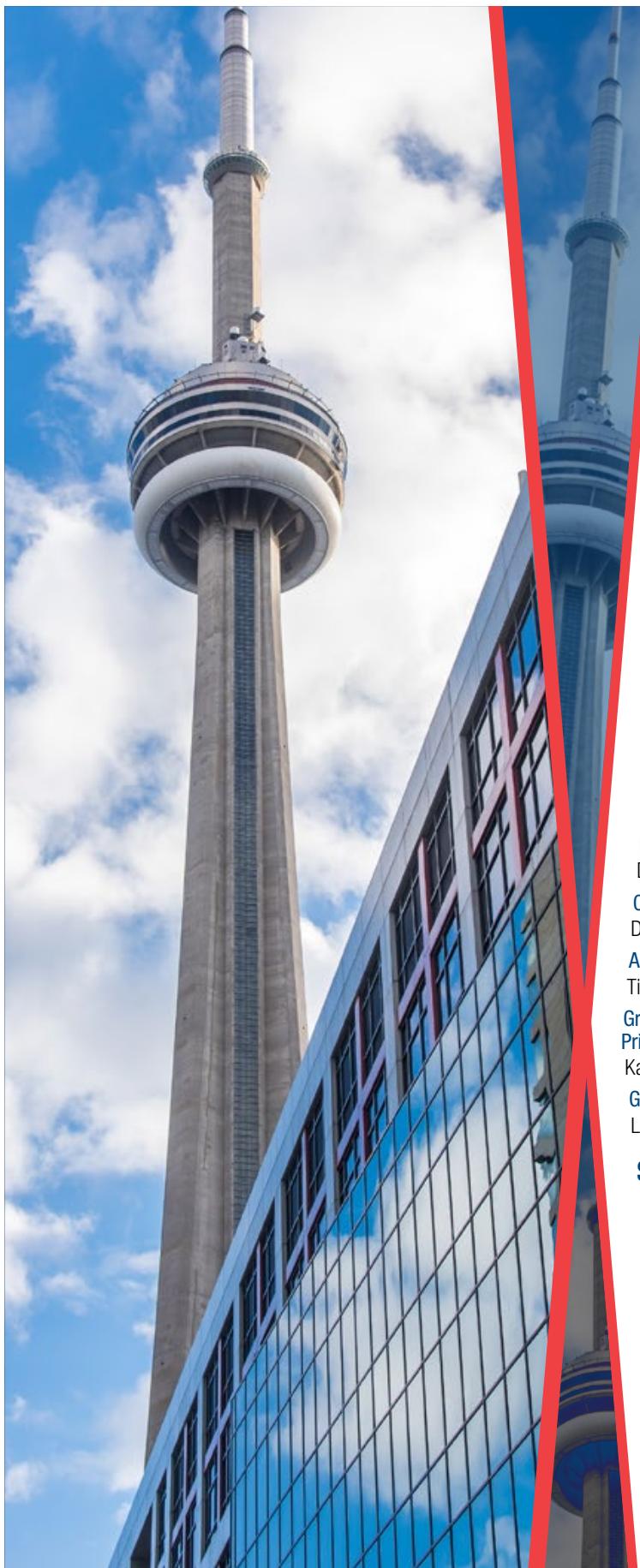
Sur le site web vous pouvez

- Trouver du matériel libre de droit relié au thème: projets, idées, logiciels, à utiliser dans la classe, lors de grands événements ou de petites activités destinées aux enfants ou au grand public;
- Trouver un mode d'emploi sur comment organiser une activité;
- Afficher votre activité sur une carte interactive;

Comment célébrerez-vous?

- Célébrerez-vous dans votre classe?
- Voulez-vous organiser une petite exposition et/ou des activités interactives dans votre communauté locale?
- Votre société mathématique nationale et/ou votre association d'enseignants en mathématiques vont-elles organiser des événements d'envergure nationale?
- Allez-vous célébrer avec un pays voisin?

Commencez à penser comment vous voulez célébrer. Nous pouvons aider. www.idm314.org



DECEMBER 6-9 DÉCEMBRE, 2019

2019 CMS Winter Meeting Réunion d'hiver de la SMC 2019

Toronto, ON

Plenary speakers | Conférences plénierées

Maria Chudnovsky (Princeton)
Sarah Mayes Tang (Toronto)
Antonio Montalban (California)
Kirsten Morris (Waterloo)
Malabika Pramanik (British Columbia)
Lauren K. Williams (Harvard)

Public Lecture | Conférence publique

David Earn (McMaster)

Prizes | Prix

Doctoral Prize Lecture | Conférence de prix de doctorat
Dr. Mikhail Karpukhin (California)
Coxeter James Prize | Conférence de prix de Coxeter-James
Dr. Jacob Tsimerman (Toronto)
Adrien Pouliot Prize | Conférence de prix Adrien-Pouliot
Tiina Hohn (MacEwan)
Graham Wright Award for Distinguished Service |
Prix Graham-Wright pour service méritoire
Karl Dilcher (Dalhousie)
G. de B. Robinson Award | Prix G. de B. Robinson
Lars Louder (University College London), Henry Wilton (Cambridge)

Scientific Directors | Directeurs Scientifiques

Jane Heffernan (York) jmheffer@yorku.ca
Patrick Ingram (York) pingram@yorku.ca



WINTER19/cms.math.ca
HIVER19.smc.math.ca



CMS WINTER MEETING | RÉUNION D'HIVER DE LA SMC

DECEMBER 6-9 DÉCEMBRE, 2019

NEW IN 2019! | NOUVEAU EN 2019!

TORONTO, ON

MINI-COURSES | MINI-COURS

- Control of Partial Differential Equations | Contrôle des équations aux dérivées partielles
- Iwasawa Theory of Fine Selmer Groups | Théorie d'Iwasawa sur les groupes de Selmer finis
- Mathematical Finance | Finances mathématiques
- Mathematical Programming with Maple Workshop | Atelier de programmation mathématique Maple
- Modeling and Dynamics of Mosquito Population and Transmission of Mosquito-borne Diseases | Modélisation et dynamique d'une population de moustiques et
- Modeling Infestations using Bayesian Networks | Modélisation des infestations avec les réseaux Bayésiens
- On the classification of simple nuclear C*-algebras | Sur la classification des C*-algèbres nucléaires simples
- Topological Data Analysis | Analyse topologique de données transmission des maladies émises par les moustiques
- Vertex Pursuit Games on Graphs | Jeux de poursuite vertex sur graphes

CHILDCARE | SERVICE DE GARDE D'ENFANTS

Parents are welcome to bring their children. CMS will be offering childcare from Saturday to Monday for registered participants during the 2019 Winter Meeting in Toronto. Register online. If you are a CMS member this service will be complimentary.

Lors la Réunion d'hiver 2019 à Toronto, un service de garde sera offert sur place, de samedi à lundi, aux parents inscrit.e.s qui souhaitent amener leurs enfants. Ce service sera gratuit pour les membres de la Société.





Canadian Mathematical Society
Société mathématique du Canada

JUNE 5-8 JUIN, 2020

CMS 75th Anniversary Summer Meeting

Réunion d'été du 75^e anniversaire de la SMC

Ottawa, ON

Plenary speakers | Conférences plénierées:

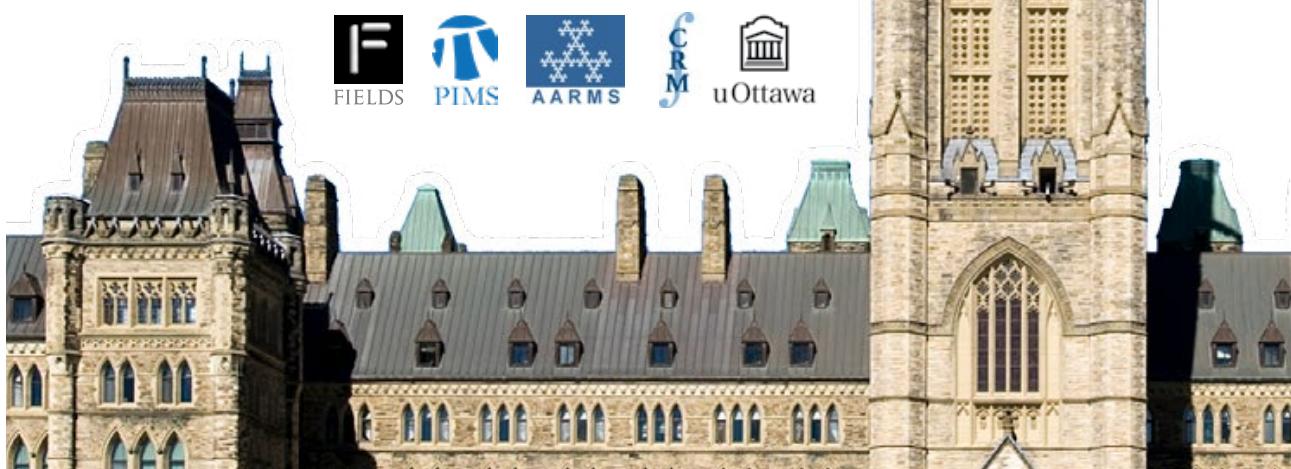
Henri Darmon (McGill)
Moon Duchin (Tufts)
Matilde Marcolli (Toronto)
Aaron Naber (Northwestern)
Ian Putnam (Victoria)

Public Lecture | Conférence publique:

Anne Broadbent (Ottawa)

Scientific Directors | Directeurs scientifiques

Ailana Fraser (University of British Columbia)
Monica Nevins (University of Ottawa)
Mateja Šajna (University of Ottawa)



uOttawa

Mini-Courses

The Canadian Mathematical Society (CMS) welcomes and invites proposals for mini-courses for the CMS 75th Anniversary Summer Meeting in Ottawa from June 5-8, 2020.

Since 2019, the CMS meeting programme has included a limited number of three-hour mini-courses with the following objectives:

1. Initiating attendees to the subject of a novel scientific session, so as to broaden the scope of its audience and appeal; or
2. Introducing attendees to a cutting-edge area of applied mathematics, for both research and professional interests; or
3. Providing professional development opportunities and advice, particularly for graduate students and new PhDs.

The CMS 75th Anniversary Summer Meeting mini-courses will be held Friday, June 5th and Monday June 8th. Attendees will be charged a small registration fee.

Proposals should include:

1. The names, affiliations, and contact information of the main organizers;
2. A title and brief description of the focus and purpose of the mini-course, being particularly clear on how it meets one of the three objectives outlined above;
3. A brief description of the anticipated mathematical background of the audience.

As the number of mini-courses is limited, please submit your proposal to the Scientific Directors (below) **before December 30, 2019**.

With thanks,

Scientific Directors:

Ailana Fraser (University of British Columbia)
afraser@math.ubc.ca

Monica Nevins (University of Ottawa)
mnevins@uottawa.ca

Mateja Šajna (University of Ottawa)
msajna@uottawa.ca



Ottawa Tourism

Mini-cours

La Société mathématique du Canada (SMC) encourage et invite les propositions de mini-cours pour la réunion d'été du 75^e anniversaire de la SMC à Ottawa du 5 au 8 juin 2020.

Depuis 2019, le programme de réunions de la SMC comprend un nombre limité de mini-cours de trois heures avec les objectifs suivants:

1. Initier les participants au sujet d'une session scientifique novatrice, afin d'attirer et d'élargir la portée de son public; ou
2. Présenter aux participants un domaine de pointe en mathématiques appliquées, tant pour la recherche que pour les intérêts professionnels; ou
3. Fournir des opportunités de développement et de conseil professionnel, en particulier pour les étudiants et les étudiantes des cycles supérieurs et les nouveaux et nouvelles titulaires d'un doctorat.

Les mini-cours de la réunion d'été du 75^e anniversaire de la SMC auront lieu le vendredi 5 juin et le lundi 8 juin. Les participants devront payer un petit montant en frais d'inscription.

Les propositions doivent inclure:

1. Les noms, affiliations et coordonnées des principaux organisateurs;
2. Un titre et une brève description de l'objectif et du but du mini-cours, indiquant en particulier comment il répond à l'un des trois objectifs décrits ci-dessus;
3. Une brève description des connaissances en mathématiques attendues de son public.

Le nombre de mini-cours est limité. Veuillez soumettre votre proposition avant le **30 décembre 2019**

Avec nos remerciements,

Les directrices scientifiques :

Ailana Fraser (University of British Columbia)
afraser@math.ubc.ca

Monica Nevins (Université d'Ottawa)
mnevins@uottawa.ca

Mateja Šajna (Université d'Ottawa)
msajna@uottawa.ca

2020 CMS Winter Meeting

December 4-7, 2020

Deadline: March 30, 2020

Le Centre Sheraton Montreal

The Canadian Mathematical Society (CMS) welcomes and invites session proposals and mini course proposals for the 2020 CMS Winter Meeting in Montreal from December 4-7.

CALL FOR SESSIONS

Proposals should include (1) names, affiliations, and contact information for all session co-organizers, (2) title and brief description of the focus and purpose of the session, (3) a preliminary list of potential speakers, with their affiliations and if they have agreed to participate, along with a total number of expected speakers.

Sessions will take place December 5, 6, and 7. The meeting schedule will accommodate 12 speakers per full day, and 5 or 7 per half day. Sessions will be advertised in the CMS Notes, on the web site and in the AMS Notices. Speakers will be requested to submit abstracts, which will be published on the web site and in the meeting program. Those wishing to organize a session should send a proposal to the Scientific Directors and copy the CMS office. Those submitting proposals are encouraged to pay attention to the diversity of both the session invitees and the proposed session organizers.

Proposals should be submitted by **March 30, 2020**.

CALL FOR MINI COURSES

The CMS is organizing three-hour mini-courses to add more value to meetings and make them attractive for students and researchers to attend.

The mini-courses will be held on Friday afternoon, December 4th, before the public lecture, and include topics suitable for graduate students, postdocs and other interested parties.

Proposals should include names, affiliations, and contact information for all the mini course co-organizers and title and brief description of the focus of the mini course

Scientific Directors

Michael Lipnowski (McGill University)
michael.lipnowski@mcgill.ca

Brent Pym (McGill University)
brent.pym@mcgill.ca

CMS Office

meetings@cms.math.ca

Réunion d'hiver de la SMC 2020

4-7 décembre 2020

Date limite : 30 mars, 2020

Le Centre Sheraton Montréal

La Société mathématique du Canada (SMC) invite la communauté mathématique à proposer des sessions et des mini-cours pour sa Réunion d'hiver 2020, qui se tiendra à Montréal du 4 au 7 décembre.

APPEL DE PROPOSITIONS DE SESSIONS

Ces propositions doivent comprendre : 1) le nom, l'affiliation et les personnes à contacter pour toutes les coorganisateurs et coorganisatrices de la session; 2) le titre et une brève description de l'orientation et des objectifs de la session; 3) une liste préliminaire de conférenciers potentiels avec leurs affiliations et leur intention de participer, ainsi que le nombre de conférenciers prévus.

Les sessions se dérouleront les 5, 6, et 7 décembre. Le format de la Réunion peut accommoder 12 conférenciers par journée pleine, et 5 ou 7 par demi-journée. Toutes les sessions seront annoncées dans les Notes de la SMC, sur le site Web et dans les notices de l'AMS. Les conférenciers devront présenter un résumé, qui sera publié sur le site Web et dans le programme de la Réunion. Toute personne qui souhaiterait organiser une session est priée de faire parvenir une proposition à nos directeurs scientifiques et mettre le bureau exécutif en cc. Nous vous invitons, dans votre proposition, à porter attention à la diversité des personnes invitées et des organisateurs et des organisatrices de la session proposée.

Les propositions doivent être soumises avant d'ici le **30 mars, 2020**.

APPEL DE PROPOSITIONS DE MINI COURS

À partir de cet été, la SMC organisera des mini-cours de trois heures pour accroître l'intérêt pour ses réunions et inciter plus d'étudiants et de chercheurs à y assister.

Les mini-cours auront lieu le vendredi 4 décembre en après-midi, avant la conférence publique, et porteront sur des sujets adaptés aux étudiants des cycles supérieurs, aux postdoctorants ou à toute personne intéressée.

Ces propositions doivent comprendre : le nom, l'affiliation et les personnes à contacter pour toutes les coorganisateurs et les organisatrices du mini-cours et le titre est une brève description du thème principal du mini-cours.

Directeurs scientifiques

Michael Lipnowski (McGill University)
michael.lipnowski@mcgill.ca

Brent Pym (McGill University)
brent.pym@mcgill.ca

Bureau exécutif

meetings@cms.math.ca

Call for CMS Meeting University Hosts

Deadline: December 16, 2019

The Canadian Mathematical Society (CMS) welcomes and invites host proposals from Canadian Universities for the 2021 CMS Winter Meeting, the 2022 CMS Winter Meeting and the 2023 CMS Summer Meeting.

CMS will provide all logistical support and contract negotiation with local venues. CMS is looking for Canadian Universities who are willing and able to showcase their department and University to students and faculty from across Canada. It is asked that proposals include the following information:

1. LOCATION

How would people get from the airport to the venue? What are the reasons your city may be of interest to Canadian Mathematicians?

2. SITE

(For summer meetings) Describe your University where the meeting would be held. Which building would the meeting be in and how many rooms are available for meeting sessions and plenaries? What technological support is available in session rooms? Will these rooms be available during the proposed dates?

(For winter meetings) Do you have a venue in mind for the meeting, is your University available to host the meeting onsite? If not, CMS will find a property outside the university.

3. LODGING

Is your university able to offer any residence lodging during the conference dates? CMS will take care of contracting and negotiating with hotels.

4. HOST UNIVERSITY

Please describe briefly your institution and department. What funding support will the Host University have for the CMS Meeting? Is the University available for regular calls and updates on the meeting progress? Is the Host University able to commit and provide at least one scientific director for the meeting? What level of participation do you think there might be from academics at your institution?

The CMS Meetings typically run from Friday to Monday on the first weekend in June and December but we are open to other possibilities. Summer meetings typically have 250-350 registrants and winter meetings are typically 400-600 in larger cities.

Please admit your submissions to Sarah Watson (meetings@cms.math.ca) before December 16th, 2019.

Appel de mise en nomination pour l'accueil de la Réunion de la SMC

Date d'échéance : Le 16 décembre 2019

La Société mathématique du Canada (SMC) sollicite les universités canadiennes souhaitant accueillir les Réunions d'hiver 2021 et 2022 et la Réunion d'été 2023 de la SMC d'envoyer leurs propositions.

La SMC se charge du soutien logistique et de toute négociation de contrats auprès des fournisseurs locaux. La SMC est à la recherche d'Universités canadiennes disposées à mettre en valeur leur département et leur université auprès des étudiant.e.s et des professeur.e.s partout au Canada. Les propositions doivent contenir les informations suivantes :

1. LOCALISATION

Comment les personnes participant à la Réunion pourront-elles se rendre au lieu depuis l'aéroport? Pourquoi votre ville intéressera-t-elle les mathématicien.ne.s canadien.ne.s?

2. SITE

(Pour la Réunion d'été) Une description de votre Université où aura lieu la réunion.

Les immeubles où sera tenue la réunion et le nombre de salles disponibles pour les sessions plénierées et parallèles. Les technologies disponibles dans les salles. La disponibilité des salles pendant les dates proposées.

(Pour les Réunions d'hiver) Le lieu de la Réunion : Votre Université est-elle en mesure d'accueillir la réunion sur place? Sinon, la SMC se charge de trouver un lieu en dehors de l'Université.

3. LOGEMENT

Votre Université sera-t-elle en mesure d'offrir des logements pendant les dates de la réunion? La SMC se charge de toutes les négociations auprès des hôtels.

4. UNIVERSITÉ HÔTE

Veuillez décrire votre établissement et votre département. Quels sont les soutiens financiers offerts par l'Université à la SMC? Votre Université est-elle en mesure d'être régulièrement en contact avec la Société pour avancer l'organisation de la Réunion? Y a-t-il au moins un directeur ou une directrice scientifique qui commettra son temps à la Réunion durant les dates proposées? Quel sera le taux de participation des membres de votre établissement?

Les Réunions de la SMC ont normalement lieu du vendredi au lundi de la première fin de semaine de juin et de décembre, mais nous sommes ouvert.e.s à d'autres possibilités. Les Réunions d'été reçoivent typiquement entre 250 et 350 participant.e.s et les Réunions d'hiver entre 400 et 600 participant.e.s quand elles ont lieu dans de grandes villes.

Veuillez envoyer vos propositions à Sarah Watson (reunions@smc.math.ca) avant le 16 décembre 2019.

2020 Doctoral Prize

The CMS Doctoral Prize recognizes outstanding performance by a doctoral student. The prize is awarded to one or two recipients 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.

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 Doctoral Prize will consist of an award of \$500, a two-year complimentary membership in the CMS, a framed Doctoral Prize 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 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, 2020**.

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, 2020, to docprize@cms.math.ca.

Prix de doctorat 2020

La SMC a créé ce **Prix de doctorat** pour récompenser le travail exceptionnel d'un.e étudiant.e au doctorat. Le prix sera décerné à une personne qui aura reçu son diplôme de troisième cycle d'une université canadienne l'année précédente (entre le 1er janvier et le 31 décembre) et dont les résultats pour l'ensemble des études supérieures seront jugés les meilleurs. La dissertation constituera le principal critère de sélection (impact des résultats, créativité, qualité de l'exposition, etc.), mais ne sera pas le seul aspect évalué. On tiendra également compte des publications de l'étudiant.e, de son engagement dans la vie étudiante et de ses autres réalisations.

Les mises en candidature qui ne seront pas choisies dans leur première compétition seront considérées pour l'année suivante (sans possibilité de mise à jour du dossier), et seront révisées par le comité de sélection du Prix de doctorat l'an prochain.

Le lauréat ou la lauréate du Prix de doctorat de la SMC aura droit à une bourse de 500 \$. De plus, la SMC lui offrira l'adhésion gratuite à la Société pendant deux ans et lui remettra un certificat encadré et une subvention pour frais de déplacements lui permettant d'assister à la réunion de la SMC où il recevra son prix et présentera une conférence.

Candidatures

Les candidat.e.s doivent être nommés par leur université; la personne qui propose un.e candidat.e doit se charger de regrouper les documents décrits aux paragraphes suivants et de faire parvenir la candidature à l'adresse ci-dessous. La SMC a pour but de promouvoir et de célébrer la diversité au sens le plus large. Nous encourageons fortement les directeurs et directrices de département et les comités de mise en candidature à proposer des collègues exceptionnels sans distinction de race, de genre, d'appartenance ethnique ou d'orientation sexuelle. Les candidatures doivent parvenir à la SMC au plus tard le **31 janvier 2020**.

Le dossier sera constitué des documents suivants :

- Un curriculum vitae rédigé par l'étudiant.e.
- Un résumé du travail du candidat ou de la candidate d'au plus dix pages, rédigé par l'étudiant.e, où il ou elle décrira brièvement sa thèse et en expliquera l'importance, et énumérera toutes ses autres réalisations pendant ses études de doctorat.
- Trois lettres de recommandation, dont une du directeur ou d'une directrice de thèse et une d'un.e examinateur.e de l'extérieur (une copie de son rapport serait aussi acceptable). Le comité n'acceptera pas plus de trois lettres de recommandation.

Veuillez faire parvenir tous les documents par voie électronique, de préférence en format PDF, au plus tard le 31 janvier 2020 à prixdoc@smc.math.ca.

2020 Adrien Pouliot Award

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, 2020**.

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.

Prix Adrien-Pouliot 2020

Nous sollicitons la candidature de personne ou de groupe de personnes ayant contribué d'une façon importante et soutenue à des activités mathématiques éducatives au Canada. Le terme « contributions » s'emploie ici au sens large; les candidat.e.s pourront être associé.e.s à une activité de sensibilisation, un nouveau programme adapté au milieu scolaire ou à l'industrie, des activités promotionnelles de vulgarisation des mathématiques, des initiatives spéciales, des conférences ou des concours à l'intention des étudiant.e.s, etc.

La SMC a pour but de promouvoir et de célébrer la diversité au sens le plus large. Nous encourageons fortement les directeurs et les directrices de département et les comités de mise en candidature à proposer des collègues exceptionnel.le.s sans distinction de race, de genre, d'appartenance ethnique ou d'orientation sexuelle.

Les mises en candidature doivent parvenir au bureau de la SMC **avant le 30 avril 2020**.

Veuillez faire parvenir votre mise en candidature par voie électronique, de préférence en format PDF, à prixap@smc.math.ca.

Conditions de candidature

- Inclure les coordonnées des candidat.e.s ainsi que des présentateurs et des présentatrices.
- Décrire en quoi le et la candidat.e a contribué de façon soutenue à des activités mathématiques. Donner un aperçu de la période couverte par les activités visées et du succès obtenu. La description ne doit pas dépasser quatre pages.
- Le dossier de candidature comportera deux lettres d'appui signées par des personnes autres que le présentateur ou la présentatrice.
- Il n'est pas nécessaire d'inclure des curriculums vitae, car les renseignements qui s'y trouvent et qui se rapportent aux activités éducatives visées devraient figurer sur le formulaire de mise en candidature et dans les autres documents énumérés ci-dessus.
- Veuillez indiquer si la candidature a été soumise l'année précédente.
- Les membres du Comité d'éducation de la SMC ne pourront être candidat.e.s pour l'obtention d'un prix pendant la durée de leur mandat au Comité.

Renouveler une mise en candidature

Il est possible de renouveler une mise en candidature présentée l'année précédente, pourvu que l'on en manifeste le désir avant la date limite. Dans ce cas, le présentateur ou la présentatrice n'a qu'à soumettre des documents de mise à jour puisque le dossier original a été conservé.

Adrien Pouliot Award/ Prix Adrien-Pouliot

Tiina Hohn (*MacEwan*)



Tiina Hohn is a recently retired assistant professor from the MacEwan University in Edmonton, Alberta. Her love of teaching and passion for mathematics have been her principal drives since 1983. In addition to teaching undergraduate courses at MacEwan she has also been involved with many outreach activities in local schools. *"The love of mathematics and the passion to reach out to students at all levels is apparent in every line of Tiina's life. Comments from students and colleagues show the depth of her dedication to the well-being of her students and the community as a whole,"* said Joseph Khoury, Chair of the CMS Education Committee, which adjudicates the Adrien Pouliot Award.

Récemment retraitée, Tiina Hohn était professeure agrégée à l'Université MacEwan à Edmonton, en Alberta. Son amour pour l'enseignement et sa passion pour les mathématiques ont marqué son trajet professionnel depuis 1983. En plus de donner des cours universitaires de premier cycle, Tiina s'est aussi engagée dans des activités variées auprès des écoles locales. « *L'amour des mathématiques et la passion pour atteindre les étudiant.e.s de tous les niveaux se manifestent dans tous les aspects de la vie de Tiina. Les commentaires des étudiant.e.s et des collègues montrent la profondeur de son dévouement au bien-être des étudiant.e.s et de la communauté en général,* » souligne Joseph Khoury, le président du comité d'éducation à la SMC, qui décerne aussi le prix Adrien-Pouliot.

Graham Wright Award for Distinguished Service Prix Graham-Wright pour service méritoire

Karl Dilcher (*Dalhousie*)



Karl Dilcher's work with CMS publications has been longstanding, and has ranged from Co-Editor-in-Chief of the CMS Books in Mathematics Series, Contributing Editor of book reviews for the CMS Notes, and to selecting and coordinating with a publishing house partner for CMS journals. He has also served on the CMS Board of Directors as Vice-president and Director, among other CMS committees and activities. His service is impressive and extends to other activities beyond the CMS. He served his University as Department Chair including serving in various panels, committees and ad-hoc committees over the years, and he maintains a thriving and productive research group at Dalhousie. He is also very instrumental to the operations of The Fibonacci Association and their journal, Fibonacci Quarterly.

Karl Dilcher est un collaborateur de longue date des publications de la SMC, notamment comme rédacteur en chef adjoint de la collection Ouvrages de mathématiques de la SMC, collaborateur à la rédaction des comptes rendus de livres pour les Notes de la SMC et responsable de la sélection et de la coordination auprès d'une maison d'édition partenaire pour les revues de la SMC. Entre autres participations à des comités et activités de la SMC, il a aussi siégé au conseil d'administration de la SMC comme vice-président et administrateur. Ses impressionnantes états de service dépassent le cadre de la SMC. Il a servi son université comme chef de département et participé à de nombreux panels, comités et comités spéciaux au fil des ans, en plus d'animer un groupe de recherche prolifique à Dalhousie. Il joue également un rôle essentiel dans les activités de l'Association Fibonacci et de sa revue, le Fibonacci Quarterly.

2020 Graham Wright Award for Distinguished Service

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 and be submitted by **March 31, 2020**.

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

G. de B. Robinson Award/ Prix G. de B. Robinson

Lars Louder (University College London) and
Henry Wilton (University of Cambridge)



Lars Louder



Henry Wilton

Lars Louder (University College de Londres) et Henry Wilton (Université de Cambridge) sont les lauréats du prix G. de B. Robinson de la Société mathématique du Canada (SMC) 2019 pour leur article « Stackings and the W-cycles Conjecture » paru dans le *Bulletin canadien de mathématiques* (vol. 60(3), 2017, p. 604-612). « L'article de MM. Louder et Wilton repose sur une idée magnifique, créative, élégante et originale pour prouver la conjecture des cycles W (proposée dans l'article de Daniel T. Wise : Bull. London Math. Soc. 37(2005), no 5, 697-705) sur le nombre de lifts d'un cycle dans un groupe libre le long d'une immersion », soulignent les rédacteurs en chef du BCM, Jie Xiao et Xiaoqiang Zhao.

Lars Louder (University College London) and Henry Wilton (University of Cambridge) have been named the recipients of the Canadian Mathematical Society's (CMS) 2019 G. de B. Robinson Award for their paper “*Stackings and the W-cycles Conjecture*” (Canadian Mathematical Bulletin Vol. 60(3), 2017 pp.604-612). “Louder and Wilton’s paper utilized a beautiful, creative, elegant and original idea to prove the W-cycles conjecture (proposed in Daniel T. Wise’s paper: Bull. London Math. Soc. 37(2005),no.5, 697-705) on the number of lifts of a cycle in a free group along an immersion” said the CMB Editors-in-Chief Jie Xiao & Xiaoqiang Zhao.

Doctoral Prize/ Prix de doctorat

Dr. Mikhail Karpukhin
(University of California at Irvine)



Mikhail Karpukhin is an outstanding young mathematician working in the area of geometric spectral theory. His thesis consists of a series of striking results among which an isoperimetric inequality for the first Laplace eigenvalue on non-orientable surfaces extending celebrated results of Yang-Yau and Li-Yau from the 80’s, new upper bounds on the Steklov eigenvalues of a manifold – best known result to-date in the case of a surface of given genus and boundary components, and explicit upper bounds on all eigenvalues of the Dirichlet-Neumann map for differential forms on a manifold of arbitrary dimension. In addition, Karpukhin’s joint work with Nadirashvili, Penskoi and Polterovich provides a complete solution of the isoperimetric problem for the Laplace-Beltrami eigenvalues on the 2-dimensional sphere.

Mikhail Karpukhin est un jeune mathématicien hors pair qui travaille dans le domaine de la théorie spectrale géométrique. Sa thèse consiste en une série de résultats saisissants parmi lesquels une inégalité isopérimétrique pour la première valeur propre du laplacien sur des surfaces non orientables, améliorant ainsi les résultats de Yang-Yau et de Li-Yau dans les années 80; de nouvelles limites supérieures pour les valeurs propres de Steklov, soit le meilleur résultat obtenu à ce jour dans le cas d'une surface d'un genre et de composantes limites données; et des limites supérieures explicites sur toutes les valeurs propres de l'opérateur Dirichlet-Neumann pour des formes différentielles sur une variété de dimensions arbitraires. De plus, en collaboration avec Nadirashvili, Penskoi et Polterovich, il fournit une solution complète au problème isopérimétrique pour les valeurs propres de Laplace-Beltrami sur la sphère en dimension deux.

Prix Graham-Wright pour service méritoire 2020

En 1995, la Société mathématique du Canada a créé un prix pour récompenser les personnes qui contribuent de façon importante et soutenue à la communauté mathématique canadienne et, notamment, à la SMC. Ce prix était renommé à compter de 2008 en hommage de Graham Wright pour ses 30 ans de service comme Directeur administratif et secrétaire de la SMC.

La SMC a pour but de promouvoir et de célébrer la diversité au sens le plus large. Nous encourageons fortement les directeurs ou les directrices de département et les comités de mise en candidature à proposer des collègues exceptionnel.le.s sans distinction de race, de genre, d'appartenance ethnique ou d'orientation sexuelle.

Pour les mises en candidature prière de présenter des dossiers avec une argumentation convaincante et de les faire parvenir, **le 31 mars 2020** au plus tard.

Veuillez faire parvenir tous les documents par voie électronique, de préférence en format PDF, avant la date limite à prixgw@smc.math.ca.

Krieger-Nelson Prize/ Prix Krieger-Nelson

Dr. Julia Gordon (*UBC*)



Dr. Julia Gordon works in representation theory of p-adic groups related to Langlands Program, and motivic integration. In many of her results, she applies model theory (specifically, motivic integration) to arithmetic questions. In rough terms, motivic integration makes it possible to do integration on p-adic fields uniformly in p. With Raf Cluckers and Immanuel Halupczok, Gordon used this technique to prove uniform estimates on orbital integrals that have an application in the study of L-functions.

Les travaux de Julia Gordon portent sur la théorie de la représentation des groupes padiques en lien avec le programme de Langlands et sur l'intégration motivique. Dans bon nombre de ses résultats, elle applique la théorie des modèles (en particulier, l'intégration motivique) à des questions arithmétiques. En gros, les intégrations motiviques permettent d'intégrer uniformément les champs padiques dans p. Avec Raf Cluckers et Immanuel Halupczok, elle a utilisé cette technique pour prouver des estimations uniformes sur les intégrales orbitales ayant une application dans l'étude des fonctions-L.

Coxeter-James Prize/ Prix Coxeter-James

Dr. Jacob Tsimerman (*Toronto*)



Jacob Tsimerman is an outstanding young mathematician who earned his doctorate in Pure Mathematics at Princeton in 2011 under the supervision of P. Sarnak. His work is a mixture of transcendence theory, analytic number theory and arithmetic geometry. Early in his career, Dr. Tsimerman obtained remarkable results related to Andre-Oort conjecture. This conjecture is concerned with the behavior of collections of special points inside Shimura varieties.

Jacob Tsimerman est un jeune mathématicien exceptionnel qui a obtenu son doctorat en mathématiques pures à Princeton en 2011 sous la direction de P. Sarnak. Son travail touche à la fois la théorie des nombres transcendants, la théorie analytique des nombres et la géométrie arithmétique. Au début de sa carrière, il a obtenu des résultats remarquables liés à la conjecture d'André-Oort. Cette conjecture concerne le comportement des ensembles de points spéciaux dans les variétés de Shimura.

Request for Submissions!

Research Notes brings mathematical research ideas forth to the CMS readership in a generally accessible manner that promotes discussion of relevant topics including research (both pure and applied), activities, and noteworthy news items. Comments and suggestions are welcome.

Submissions are currently being sought for volume (51) of *CMS Notes*. To contribute contact Patrick Ingram, York University (pingram@yorku.ca)

Demande de soumission!

Les Notes de recherche présentent des sujets mathématiques aux lecteurs de la SMC dans un format généralement accessible qui favorise les discussions sur divers sujets pertinents, dont la recherche (pure et appliquée), les activités et des nouvelles dignes de mention. Vos commentaires et suggestions sont les bienvenus.

Nous acceptons en ce moment des articles pour le volume 51 des *Notes de la SMC*. Pour contribuer à ce volume, veuillez contacter à Patrick Ingram, Université York (pingram@yorku.ca)

Excellence in Teaching Award/ Prix d'excellence en enseignement

Andrea Fraser (*Dalhousie*)



There is an overwhelming amount of positive student feedback that speaks to Dr. Fraser's dedication and commitment to student success, and to the originality and exceptional clarity of her presentation. Students praise her ability to make difficult concepts easy and intuitive, and her lecturing style, which makes students feel they are "discovering" the material. Her colleagues write that "she very clearly cares and nurtures her students, and she embraces the weak students as well as challenges the strong".

Les étudiant.e.s ne tarissent pas d'éloges à l'égard de cette enseignante, tant sur son dévouement et son engagement envers la réussite des étudiant.e.s que sur l'originalité et la qualité exceptionnelle de ses cours. Ils apprécient sa capacité à simplifier les concepts difficiles, mais aussi ses cours magistraux qui leur donnent l'impression de « découvrir » la matière. Ses collègues la décrivent comme une personne qui se préoccupe vraiment de ses étudiant.e.s et qui encourage ceux qui éprouvent des difficultés, tout en poussant les plus avancés à se surpasser.

Jeffery-Williams Prize/ Prix Jeffery-Williams

Dr. Jeremy Quastel (*Toronto*)



Dr. Quastel is awarded the 2019 Jeffery-Williams prize for his groundbreaking results in probability and non-equilibrium statistical mechanics, in particular, his recent discovery with Matetski and Remenik of the complete integrability of TASEP, and through a scaling limit, the strong coupling fixed point of the KPZ universality class. The class contains random interface growth models and directed polymer free energies. An example is the famous Kardar-Parisi-Zhang non-linear stochastic partial differential equation, which gives the class its name; TASEP is its most popular discretization. The KPZ fixed point is expected to describe the universal long time large-scale fluctuations for all such systems.

Le prix Jeffery-Williams 2019 lui est remis pour ses résultats novateurs en étude des probabilités et en mécanique statistique hors d'équilibre, en particulier pour sa récente découverte, avec Matetski et Remenik, de l'intégrabilité complète du processus d'exclusion simple totalement asymétrique (TASEP en anglais) et, à travers une limite à l'échelle, du point fixe de couplage fort de la classe d'universalité de KPZ. La classe contient des modèles de croissance à interface aléatoire et des énergies dirigées sans polymère, par exemple la célèbre équation différentielle aux dérivées partielles non linéaire et stochastique de Kardar-Parisi-Zhang (d'où le nom de la classe), dont le TASEP est la discréttisation la plus populaire. Le point fixe KPZ devrait décrire les fluctuations universelles à grande échelle et à long terme de tous ces systèmes.

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Annual Fundraising Campaign

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 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 the CMS a chance to hear feedback from members on what they enjoy about the Society and the ways its programs could be improved.

Once again, at the close of the year, the CMS plans to contact and thank its community, encourage further membership in the Society, and invite its members to give as generously as possible to the CMS.

With regular donations from members, 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 in the following ways:

- 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, David Pike (Memorial) - 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



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Campagne annuelle de financement

L'année dernière, les membres du conseil d'administration et du personnel, ainsi que les ami.e.s de la SMC, ont pris le temps de contacter les membres présent.e.s ou ancien.ne.s de la Société pour les remercier de leur participation aux activités de la SMC et les encourager à renouveler leur adhésion (s'ils ou elles ne l'avaient pas déjà fait). Cette campagne de recrutement et de collecte de fonds a été couronnée de succès et a permis aux membres de nous dire ce qu'ils aiment du fait d'être membres de la Société et d'offrir des conseils sur ce que la Société pourrait faire de mieux.

Une fois de plus, à la fin de l'année, la SMC prévoit contacter et remercier sa communauté, encourager d'autres personnes à devenir membres et inviter ses membres à donner le plus généreusement possible à la Société.

Grâce à vos dons constants, ainsi qu'à ceux de fondations, de sociétés, de gouvernements et d'établissements d'enseignement, les programmes et activités de la SMC seront améliorés, tout comme notre capacité de représenter véritablement l'ensemble de la communauté mathématique canadienne.

La SMC vous invite à réfléchir à la possibilité de faire un **don planifié**.

Ce que vous pouvez aussi faire pour aider la SMC :

- Si vous avez des contacts dans le secteur privé ou des fondations avec qui la SMC peut discuter d'éventuels partenariats, parlez-en à Zishad Lak, agente de la collecte de fonds et des communications à la SMC.

- Si vous souhaitez devenir membre d'un comité de la SMC, veuillez contacter le président du Comité des mises en candidature, David Pike (Memorial) – chair-nomc@smc.math.ca

Encouragez vos collègues à devenir membres de la SMC!

En travaillant ensemble, nous pouvons continuer à promouvoir l'avancement, la découverte, l'apprentissage et l'application des mathématiques. Si vous avez des questions ou pour obtenir plus d'informations, veuillez contacter Zishad Lak à l'adresse zlak@smc.math.ca.