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CMS NOTES de la SMC

June/juin
2019

Vice-President's Notes / Notes de la Vice-présidente

Malabika Pramanik

CMS Vice-President - Pacific / Vice-présidente de la SMC - pacifique

Conferences and ... climate?



Conferences have been a lot on my mind lately. First of all, I am at one of them as I pen this. Just a few minutes ago, I heard a beautiful presentation on a problem close to my heart. Yesterday afternoon, we participated in a vibrant problem session where ideas flew thick and fast, vigorous discussions ensued, and everyone came away with that sense of satisfaction that only a fruitful meeting of minds can impart. As CMS members, we often engage in conversations on how to improve the CMS meeting experience, enhance its global visibility, and connect to a wide swathe of the mathematical community. As conference organizers, we are always looking for ways to attract both eminent mathematicians and early-career researchers, preferably from as many different corners of the globe as budgetary constraints will allow. As advisors, we understand the importance of sending students to events with networking opportunities, where they can learn new mathematics, showcase their own work, and meet prospective employers and collaborators.

You can imagine my incredulity, followed by sinking dismay, as I sat at a seminar last week, listening to the presentation of two UBC colleagues Seth Wynes and Simon Donner (Department of Geography) as they laid out their findings and conclusions from a recent study "Addressing greenhouse gas emissions from business-related air travel at public institutions: a case study

Où il est question de congrès et de climat ?

D epuis quelque temps, je baigne dans l'univers des congrès. D'abord, au moment d'écrire ces lignes, je participe à un congrès. Il y a quelques minutes, j'assisstais à une superbe conférence à propos d'un problème qui me tient à cœur. Hier après-midi s'est tenue une séance de résolution de problèmes incroyablement dynamique (déluge d'idées, discussions animées) dont tout le monde est sorti avec ce sentiment de satisfaction incomparable qui naît des échanges fructueux. En tant que membres de la SMC, nous discutons souvent des moyens d'améliorer l'expérience des participants aux événements de la Société, d'accroître sa visibilité et d'atteindre une majorité de membres de la communauté mathématique. Puis, en tant qu'organisateurs des congrès, nous cherchons toujours à attirer d'éminents mathématiciens et de jeunes chercheurs de tous les coins du monde (dans les limites du budget). Finalement, en tant que conseillers, nous comprendrons l'importance de faire participer les étudiants à des événements qui leur donnent l'occasion de réseauter, d'approfondir leurs connaissances mathématiques, de faire valoir leur travail et de rencontrer d'éventuels employeurs ou collaborateurs.

Mais voilà que, la semaine dernière, j'ai pris part à une conférence qui a suscité chez moi un grand étonnement ... puis une immense consternation. Deux collègues du département de géographie l'Université de la Colombie-Britannique (UCB), Seth Wynes et Simon Donner, présentaient les résultats et les conclusions d'une récente étude sur les émissions de gaz à effet de serre (GES) associées au transport aérien pour

Why Do We Teach What We Teach?

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



One year's teaching is coming to an end, and it's already time to look ahead to the next. What (if anything) are you planning to change? What *can* you change? You can (perhaps after consultation with colleagues) change your textbook; but you may have difficulty finding one (apart from the "reform calculus" books) in which the first five chapters are not precalculus math (which you will probably skip), limits, derivatives, applications of derivatives, and rudimentary integration.

In many departments, the content of the "hard science" calculus courses, and maybe a few others, is largely set by the requirements of the engineering faculty, or some other group. The "life science" and "commerce" calculus courses are probably regulated more by pressure to pick examples that are suitable for the students and, above all, not to make the course too difficult. Teaching either course out of the classic *Schaum's Outline of Calculus* would be tricky; Apostol's *Calculus*, with its famous "integration-first" approach, would probably trigger decanal intervention.

But there are minor choices that are less obvious. Implicit differentiation is used by default for related-rate problems, but rarely if ever for constrained optimization problems, where it works very nicely. Somebody no doubt made a deliberate decision about this at one point, but the fact that almost every textbook follows this pattern looks just a little like peer pressure.

And what about the selection of integration techniques? Calculus textbooks get us so used to finding integrals (or, rather, antiderivatives) by substitution, parts, trig substitution, or partial fractions that it's sometimes hard to remember that there are other methods. Many integrals that are often done by parts can be done somewhat more quickly using undetermined coefficients: but this technique rarely appears in calculus textbooks. (Textbooks on differential equations all include it, of course!) Other techniques, such as the Weierstraß "tan $\frac{x}{2}$ " substitution can sometimes be found buried in the textbook's higher-numbered exercises or challenge problems, but you must hunt for them. If you compare the range of techniques in books such as Seán M. Stewart's *How To Integrate It* you may be surprised.

I'm not advocating change just for the sake of change, and we can't teach everything in two semesters. But perhaps we could be a little more aware of the decisions that we're acquiescing in with our course outlines.

Pourquoi enseignons-nous ce que nous enseignons?

Une année d'enseignement s'achève et il est déjà temps de regarder vers l'avenir. Que comptez-vous changer dans votre travail (si vous y songez)? Que pouvez-vous changer? Sans doute après avoir consulté vos collègues, vous pouvez changer de manuel. Mais vous aurez peut-être du mal à en trouver un (à part les manuels de calcul « de la réforme ») où les cinq premiers chapitres ne sont pas consacrés à une introduction au calcul (que vous passerez probablement), aux limites, aux dérivés, aux applications de dérivés et aux rudiments de l'intégration.

Dans de nombreux départements, le contenu des cours de calcul « de science pure », et peut-être quelques autres, est en grande partie déterminé par les exigences de la faculté de génie ou d'un autre groupe. Les cours de calcul des orientations « sciences de la vie » ou « commerce » sont probablement davantage encadrés par la pression de choisir des exemples adaptés à ces étudiants et, surtout, de ne pas rendre le cours trop difficile. Enseigner l'un ou l'autre de ces cours à l'aide du classique *Schaum's Outline of Calculus* serait délicat, et le faire à partir du *Calculus* de Tom M. Apostol, avec sa célèbre approche « d'intégration d'abord », vous vaudrait probablement une visite du doyen.

Toutefois, d'autres choix mineurs sont moins évidents. La différenciation implicite est utilisée par défaut pour les problèmes de taux associés, mais rarement, voire jamais, pour les problèmes d'optimisation sous contrainte, pour lesquels cette méthode fonctionne très bien. Quelqu'un a sans doute pris une décision délibérée à ce sujet à un moment donné, mais le fait que presque tous les manuels suivent ce modèle ressemble un peu à la pression des pairs.

Et qu'en est-il du choix des techniques d'intégration? Les manuels de calcul nous habituent tellement à trouver des intégrales (ou plutôt des anti-dérivés) par substitution, par parties, par substitution trigonométrique ou par fractions partielles qu'on en oublie parfois l'existence d'autres méthodes. De nombreuses intégrations souvent réalisées par parties s'obtiennent plus rapidement à l'aide de coefficients indéterminés, mais cette technique figure rarement dans les manuels de calcul. (Les manuels sur les équations différentielles l'incluent tous, bien sûr!) D'autres techniques, comme la substitution de Weierstraß « tan $\frac{x}{2}$ », sont parfois enfouies dans les exercices les plus complexes ou les problèmes de perfectionnement des manuels, mais il faut bien les chercher. Si vous comparez la gamme de techniques de manuels comme celui de Seán M. Stewart, *How To Integrate It*, vous aurez peut-être des surprises.

Je ne préconise pas le changement simplement pour le plaisir, et nous ne pouvons pas tout enseigner en deux semestres. Mais peut-être pourrions-nous être un peu plus conscients des décisions que nous entérinons en adoptant nos plans de cours.

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 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. Les lecteurs peuvent nous joindre au bureau administratif de la SMC ou à l'adresse suivante : notes-lettres@smc.math.ca.

2019 CMS MEMBERSHIP RENEWALS RENOUVELLEMENTS 2019 À LA SMC



The 2019 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

Le renouvellement pour l'an 2019 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 adhessions@smc.math.ca

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Continued from cover

of the University of British Columbia”, published in the Pacific Institute of Climate Solutions (July 2018). Wynes and Donner had conducted two analyses of business-related air travel emissions, one based on bottom-up data from eight units on campus (997 travellers) and another based on data collected by a central travel office via an online booking tool (3807 travellers), in addition to a survey of faculty attitudes about business-related air travel, and an assessment of mitigation options including investment in Information and Communications Technology (ICT).

To say that I was stunned would be an understatement. Climate change, greenhouse emissions, eco-friendly initiatives are of course a common point of discourse on all media platforms these days. I thought I had done my tiny bit by cutting down on plastic, sorting out the garbage, composting religiously, turning off switches before leaving the house and paying the carbon tax. Guilt had been confined to driving my car. Aware as I was of mathematicians engaged in exploring the consequences of climate change through sophisticated modelling methodology, or involved in the inspiring programs under “Mathematics of Planet Earth” (<http://mpe.dimacs.rutgers.edu>), I had never imagined that my own research activities could have any bearing on the future of the planet.

Yet the findings are sobering and unequivocal. Air travel emissions resulting from professional travel and predominantly to conferences, are significant in relation to other institutional emissions. Wynes and Donner estimate that “business-related air travel emissions at UBC total 26,333-31,685t CO₂e each year, equivalent to 63%-73% of the total annual emissions from the operation of the UBC campus. At a unit-by-unit level, emissions from business-related air travel in the Department of Psychology were similar to that from heating and providing electricity to the building housing the department. In the case of the Department of Geography, which recently switched to a more efficient heating system, the business-related air travel emissions were 30 times that of the building.” I could not get the stats for the Department of Mathematics. On the other hand, I do not recall any recent switches in the heating system either.

According to Wynes and Donner: “This report indicates that business-related air travel represents a substantial, unaddressed emissions burden. The emissions per UBC traveller in this study ... are equivalent to 10-13% of the greenhouse gas footprint of the average Canadian and 16-21% of that of the average BC resident. ... When extrapolated to the entire institution, annual business-related air travel emissions are equivalent to 63%-73% that of the UBC campus, and 1.3 to 1.6 times greater than the UBC emissions target for the year 2020”.

What do these numbers mean exactly? Off-hand, 10-13% of the average Canadian’s greenhouse gas footprint does not sound so bad. Wynes explains that people in BC have much smaller carbon footprints (our household energy comes from hydro instead of coal); hence the same value would occupy a larger fraction of an individual’s emissions in BC, about 16%. That means that the average person in this sample produced, simply through air

travel, 16% of the emissions that someone in BC creates through their entire annual footprint (flying, home heating, driving a car). According to Wynes, the important message here is this: the average emissions of a professor who took at least one flight in their sample are three times higher than the average graduate student who also took at least one trip. “The average professor (not associate or assistant, but fully tenured professor) had emissions of 7.52 tCO₂e, compared to 2.44 tCO₂e for graduate students. Some individuals are responsible for much more emissions than others”.

Wynes and Donner’s report goes on to say: “... many trips by air are potentially replaceable; most trips taking place at UBC are short (median length of five nights) and the most common purpose of trips was for conferences and meetings. ... Simple mitigation measures, including eliminating higher class travel, and brief, long haul trips, could have reduced emissions by 11.7% ..., while also saving money. Efforts to address the remainder of business-related air travel emissions will require changes to actual and perceived professional norms (e.g., in-person attendance at international conferences) as well as the quality and awareness of alternative technological options. While emerging technology may not be able to fully replicate the indirect benefits of in-person participation in meetings and conferences (e.g., networking, social interactions with peers), it could be critical in minimizing the need for brief single-meeting air travel discussed above, and in facilitating the broader cultural shift necessary to hold more virtual conferences, workshops, and meetings”.

The presentation I attended focused only on my home institution. The problem most definitely is not organization-specific. Curiosity led me to probe a bit more into the environmental impact of large-scale conferences. Unsurprisingly, evidence was everywhere, once I knew what to look for. In the article titled “Sustainable Science?” (in “Ethnobiology Letters”), authors Alexandra Ponette-González and Jarret Byrnes offer a few more data points: “Every year scientists showcase their research findings at large national and international conferences, some of which host thousands of participants. Regrettably, these “mega-meetings” represent a significant source of CO₂ to the atmosphere. Air travel to a single meeting can generate about 11,000 metric tons of carbon dioxide, a roundtrip flight from New York City to Brussels is 1.4 metric tons of CO₂ These statistics are at odds with the values of scientists who seek to slow the current rate of CO₂ increase in the atmosphere, and especially those concerned with climate change.” They too talk about the importance of promoting a “greater self-awareness among scientists at all levels of the need for a more sustainable scientific enterprise”, and the necessity of cultural shifts within disciplines.

What would such a cultural shift look like? Right now, virtual meetings and large-scale web conferences seem untenable substitutes for their in-person counterparts. Almost everyone who has been in virtual meetings has a story to share about the inevitable technical glitches; the lack of interactivity, audio lag, poor video quality, dropped connections. While the aviation industry races to

replace fossil fuels and explore green alternatives such as battery-powered flights, do we sit back and wait for technological innovation to catch up with our expectations? Or should conference organizers initiate cultural shifts that are within reach, by emphasizing regional participation, while using venues with enhanced ICT facilities for remote collaboration?

The real issues go deeper. Even assuming that ICT breakthroughs for virtual meetings are around the corner, how does one reconcile the ethically correct demands of the environment with imminent requirements of promotion and tenure, where the number of invitations to speak at international conferences is a universally important metric of quality? Is academic air travel a reliable predictor of professional success, or a dispensable artifact? And what about that other acknowledgment of merit - research support in the form of travel grants - that aims to bring geographically separated researchers together? Any proposed mitigating measure, such as a behavioural incentives program or employment of offsets only if locally-based, is likely to gain traction only if it is part of a larger directive that encompasses all educational institutions and funding agencies. Any academic institute or organization that unilaterally aims to incorporate progressive environmental

policies into its broader infrastructure, risks being at a competitive disadvantage in the current academic environment, at least in the early stages. Socially conscious academic organizations, such as the Lund University Centre for Sustainability Studies (Sweden) and the Tyndall Centre for Climate Change Research (UK) have already stepped up to the plate:

- <https://www.lucsus.lu.se/article/lucsus-presents-new-travel-policy-to-reduce-work-related-emissions>
- <https://tyndall.ac.uk/travel-strategy>

But these remain tiny drops in a giant bucket. There is pressing need for larger deliberation within the academic community that could lead to global academic policy changes.

Our lives are complex, for the most part a tightrope walk of balancing priorities. Our planet, that supports these lives, is more complex still. Ironically, the benefits to one often seem to conflict with the other. Yet the end goal is clear; the planet must thrive, so that we can. The way to change seems partly obscure at the moment. But change we must.

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)

Suite de la couverture

déplacements professionnels à l'UCB¹. Les chercheurs ont réalisé deux analyses des émissions associées au transport aérien pour déplacements professionnels :

- l'une fondée sur les données contributives provenant de huit unités de l'université (997 voyageurs),
- l'autre fondée sur les données recueillies par l'intermédiaire de l'outil de réservation en ligne du bureau des voyages de l'université (3807 voyageurs).

Ils ont également fait appel à un sondage d'opinion sur le transport aérien pour déplacements professionnels mené auprès du personnel enseignant et évalué des mesures d'atténuation, y compris l'investissement dans les technologies de l'information et des communications (TIC).

J'en suis sortie sidérée... et le mot est faible. Bien sûr, de nos jours, les changements climatiques, les émissions de GES et les mesures écoresponsables sont un thème récurrent dans tous les médias. Je participe à l'effort collectif : j'ai banni le plastique, je m'adonne au tri sélectif, je pratique religieusement le compostage, j'éteins les lumières avant de quitter la maison et je paie des taxes carbone. Seule l'utilisation de la voiture occasionne encore chez moi un certain sentiment de culpabilité. Je sais bien que les mathématiciens explorent les impacts des changements climatiques en faisant appel à des modèles mathématiques très complexes ou participent à de passionnantes activités du programme *Mathématiques de la planète Terre* (<http://mpe.dimacs.rutgers.edu/>). Mais jamais je n'aurais imaginé que mes activités de recherche pouvaient avoir un impact sensible sur l'avenir de la planète.

Et pourtant, l'étude de Seth Wynes et Simon Donner conclut sans équivoque que les émissions de GES attribuables aux déplacements professionnels, très majoritairement pour participer à des congrès, constituent une part importante des émissions totales de l'université. Cette conclusion m'a fait l'effet d'une douche froide. Les chercheurs estiment que « les émissions de GES imputables au transport aérien pour déplacements professionnels de l'UCB atteignent de 26 333 à 31 685 tonnes d'équivalent CO₂ par an, ce qui représente de 63 à 73 % des émissions annuelles totales relatives au fonctionnement du campus. À l'échelle de l'unité, les émissions de GES relatives au transport aérien du département de psychologie étaient similaires aux émissions relatives au chauffage et à la consommation d'électricité du bâtiment qui héberge ce département. Pour le département de géographie, qui s'est récemment doté d'un système de chauffage efficace, les émissions de GES attribuables au transport aérien pour déplacements professionnels s'élèvent à 30 fois celles du bâtiment. » Je ne sais pas ce qu'il en est pour le département de mathématiques. Mais il

ne me semble pas qu'on ait récemment amélioré le système de chauffage.

Toujours dans le rapport, on lit que « le transport aérien pour déplacements professionnels est une source d'émissions considérable, que personne ne s'emploie à réduire. Les émissions par voyageur de l'UBC [...] équivalent à 10 à 13 % des émissions de GES du Canadien moyen, et à 16 à 21 % de celles du Britannico-Colombien moyen. [...] À l'échelle de l'ensemble de l'UCB, les émissions attribuables au transport aérien pour déplacements professionnels comptent pour de 63 à 73 % des émissions du campus (soit de 1,3 à 1,6 fois la cible que l'université s'est fixée pour 2020). »

Comment interpréter ces résultats? À première vue, 10 à 13 % des émissions d'un Canadien moyen, ça n'est pas si mal. Sauf que, comme l'explique Seth Wynes, l'empreinte carbone d'un Britannico-Colombien est bien inférieure à celle d'un Canadien (parce que la principale source d'énergie des ménages de la province est l'hydroélectricité, et non le charbon). Les émissions attribuables au transport aérien représentent donc une proportion sensiblement plus élevée de la moyenne provinciale, soit environ 16 %. Par conséquent, l'individu moyen de l'échantillon produit, simplement en se déplaçant en avion, 16 % des émissions moyennes annuelles d'un résident de la Colombie-Britannique (vols, repas à la maison, utilisation de la voiture). Selon le chercheur, il faut surtout retenir que les émissions moyennes d'un professeur de l'échantillon qui a pris l'avion au moins une fois sont du triple de celles d'un étudiant des cycles supérieurs moyen qui a pris l'avion au moins une fois.

« En effet, les émissions du professeur titulaire moyen (c.-à-d. ni agrégé ni adjoint) s'élèvent à 7,52 tonnes d'équivalent CO₂, contre 2,44 pour les étudiants des cycles supérieurs. Certains produisent nettement plus d'émissions que d'autres. »

Toujours dans le rapport de Seth Wynes et Simon Donner, on lit qu'il « [...] existe des solutions de recharge pour bien des transports aériens, que, à l'UCB, la plupart des séjours effectués sont de courte durée (médiane de cinq nuits) et que la raison d'être des déplacements est, le plus souvent, la participation à des congrès ou à des réunions. Et aussi des mesures d'atténuation simples, comme l'élimination des voyages en classe autre qu'économique ou encore des longs vols pour des séjours de courte durée, auraient permis de réduire les émissions de 11,7 % [...] et de faire des économies. Pour réduire encore davantage les émissions, il faudra revoir les normes professionnelles réelles ou perçues (p. ex. la participation en personne aux congrès internationaux) et rehausser la qualité et la connaissance des solutions technologiques de remplacement. [...] Bien que les technologies émergentes ne permettent pas aux utilisateurs de bénéficier des avantages indirects de la participation en personne aux réunions et aux congrès (p. ex. le réseautage et les interactions sociales avec les pairs), elles demeurent indispensables pour minimiser le nombre de longs déplacements pour de courts séjours (p. ex. pour une seule réunion), ou pour faciliter la transition

¹ Seth WYNES et Simon DONNER, *Addressing greenhouse gas emissions from business-related air travel at public institutions: a case study of the University of British Columbia, Victoria (C.-B.), Pacific Institute of Climate Solutions, 2018, 28 p.*

vers une culture générale faisant davantage appel aux TIC pour les congrès, les ateliers et les réunions. »

La présentation à laquelle j'ai assisté ne visait que l'UCB, mais le problème n'est certainement pas exclusif à cet établissement. Par curiosité, j'ai fait des recherches sur les impacts environnementaux des grands congrès, et j'ai évidemment trouvé une abondance d'information (comme quoi qui sait ce qu'il cherche trouve assurément). Dans un article intitulé « Sustainable Science? » (paru dans *Ethnobiology Letters*), Alexandra Ponette-Gonzalez et Jarret Byrnes offrent quelques données supplémentaires : « Chaque année, les scientifiques présentent les résultats de leurs recherches lors de grands congrès nationaux et internationaux, parmi lesquels certains accueillent des milliers de participants. Malheureusement, ces mégacongrès sont une importante source d'émissions de CO₂. Par exemple, pour un seul événement, le transport aérien peut produire environ 11 000 tonnes métriques de dioxyde de carbone, et un aller-retour New York-Bruxelles représente 1,4 tonne métrique de CO₂. [...] Ces statistiques sont en contradiction avec les valeurs des scientifiques qui se disent soucieux de réduire les taux d'accumulation de CO₂ dans l'atmosphère... et particulièrement de ceux qui s'intéressent aux changements climatiques. » Ces auteurs aussi soulignent l'importance de « sensibiliser les scientifiques de tous les niveaux à la nécessité d'accroître la soutenabilité de l'entreprise scientifique » et d'opérer une transition au sein de la culture de toutes les disciplines.

Mais cette transition culturelle, comment la réaliser? À l'heure actuelle, on ne voit pas les réunions virtuelles et les grands congrès Web comme des substituts valables de la présence en personne. Presque tous ceux qui ont participé à des réunions virtuelles peuvent témoigner de péripéties techniques : perte d'interactivité, délais audio, faible qualité d'image, déconnexions intempestives. Le secteur de l'aviation cherche activement des solutions de remplacement aux carburants fossiles et explore les solutions vertes comme les aéronefs à piles. Fort bien. Mais faut-il se contenter d'attendre que les innovations technologiques répondent à nos attentes? Pourquoi les organisateurs de congrès n'amorceraient-ils pas la transition en adoptant des solutions déjà à leur portée, comme privilégier la participation régionale et choisir des installations bien équipées en TIC afin de favoriser la collaboration à distance?

Mais, en fait, le vrai problème est ailleurs. En admettant que les avancées technologiques dans le domaine des TIC élimineront bientôt les difficultés techniques, comment soumettre les exigences du cheminement professionnel des chercheurs et du personnel enseignant à une éthique de l'environnement, si le nombre d'invitations à donner une conférence dans des congrès internationaux demeure un critère de qualité universellement reconnu? Le transport par avion est-il un prédicteur fiable de réussite professionnelle ou un reliquat désormais superflu? Qu'en est-il du soutien à la recherche accordée « au mérite », sous la forme de subventions de voyage qui visent à regrouper géographiquement des chercheurs? Les mesures d'atténuation, comme des programmes d'incitatifs à l'adoption de certains comportements ou de mesures de compensation carbone réalisées localement, ne réussiront à mobiliser les acteurs que si elles s'intègrent dans une directive de portée générale qui vise l'ensemble des établissements d'enseignement et des organismes de financement. Dans le système actuel, un organisme ou un établissement d'enseignement qui prendrait l'initiative d'incorporer des politiques environnementales progressistes à sa structure globale s'imposerait un désavantage concurrentiel, du moins au début de la mise en œuvre. Des établissements d'enseignement socialement responsables, comme le Lund University Centre for Sustainability Studies (Suède) et le Tyndall Centre for Climate Change Research (Royaume-Uni), ont pris les devants :

- <https://www.lucusus.lu.se/article/lucusus-presents-new-travel-policy-to-reduce-work-related-emissions>
- <https://tyndall.ac.uk/travel-strategy>

Mais ces initiatives ne sont que des gouttelettes d'eau dans l'océan. Le milieu universitaire devra absolument se pencher sur la mise à jour des politiques dans l'ensemble des établissements de la planète.

Éternel exercice de mise en équilibre des priorités, la vie humaine est complexe. La planète qui rend cette vie possible est encore plus complexe. Mais il semble que ce qui sert l'une est souvent nuisible à l'autre. Pour survivre, il est essentiel, et même indispensable, de trouver le moyen de renverser la tendance.

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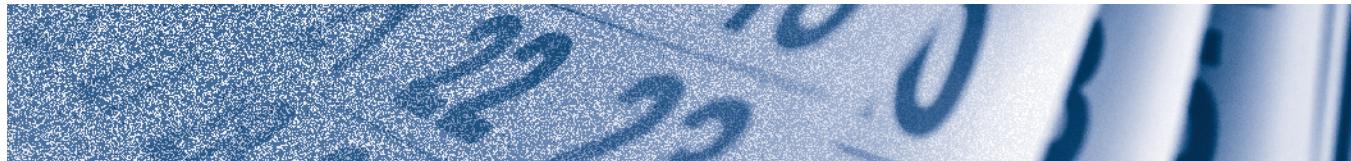


The Calendar brings current and upcoming domestic and select international mathematical sciences and education events to the attention of the CMS readership. Comments, suggestions, and submissions are welcome.

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

Le calendrier annonce aux lecteurs 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 le bienvenue.

Denise Charron, Société mathématique du canada,
(mpagent@smc.math.ca)



JUNE 2019 JUIN

- 2-4** The 2019 CSHPM/SCHPM Annual Meeting – Congress of the Humanities and Social Sciences, University of British Columbia, Vancouver, BC.
- 3-7** 14th International Conference on Finite Fields and their Applications (Fq14), Simon Fraser University, Vancouver, BC.
- 7-10** 2019 CMS Summer Meeting / Réunion d'été de la SMC 2019, University of Regina, Regina, SK / Université de Regina, Regina, SK.
- 9-13** 2019 CAIMS Meeting / Réunion SCMAI 2019, Whistler Conference Centre, Whistler, BC
- 10-14** A Celebration of Geometry, Analysis and Physics Conference honouring Niky Kamran on his 60th birthday, CRM, Montreal, QC.
- 10-14** PIMS Workshop on Arithmetic Topology, University of British Columbia, Vancouver, BC.
- 16-21** Bridging Cellular and Tissue Dynamics from Normal Development to Cancer: Mathematical, Computational, and Experimental Approaches, BIRS, Banff, AB.
- 18-21** Mathematics and its Connections to the Arts and Sciences, McGill University, Montreal, QC.
- 21-23** Innovations in New Instructor Training, BIRS, Banff, AB.
- 24-28** Conference: Homological Algebra, Microlocal Analysis and Symplectic Geometry, CRM, Montreal, QC.

JULY 2019 JUILLET

- 1-5** 11th International Symposium: Quantum Theory and Symmetries (QTS), CRM, Montreal, QC.
- 1-12** SMS 2019 Summer School: Current Trends in Symplectic Topology, CRM, Montreal, QC.
- 7-12** Algebraic Techniques in Computational Complexity, BIRS, Banff, AB
- 15-19** Summer School on Nonlinear Dynamics in Life Sciences, Fields Institute, Stewart Library, Toronto, ON.
- 15-21** 60th International Mathematical Olympiad, Bath, United Kingdom

- 21-26** 2019 Annual Meeting of the Society for Mathematical Biology, CRM, Montreal, QC.

- 24-28** Canadian Undergraduate Mathematics Conference / Congrès canadien des étudiant(e)s en mathématiques, Queen's University, Kingston, ON.

- 31-A3** MAA MathFest 2019, Cincinnati, Ohio, USA

AUGUST 2019 AOÛT

- 4-9** From Many Body Problems to Random Matrices, BIRS, Banff, AB.
- 5-9** Focus Week on Cluster Algebras and Quiver Representations, CRM, Montreal, QC.
- 9-11** Mathematics and Computer Science in Modeling and Understanding of Structure and Dynamics of Biomolecules, BIRS, Banff, AB.
- 11-16** Convex Integration in PDEs, Geometry, and Variational Calculus, BIRS, Banff, AB.
- 11-16** Mutations: Mirror Symmetry, Deformations, and Combinatorics, BIRS, Banff, AB.
- 12-16** Workshop on Quiver Varieties and Representation Theory, CRM, Montreal, QC.
- 18-23** Charge and Energy Transfer Processes: Open Problems in Open Quantum Systems, BIRS, Banff, AB.
- 19-23** Ninth Montreal Industrial Problem Solving Workshop, CRM, Montreal, QC.
- 19-23** Focus week on Quiver Varieties, CRM, Montreal, QC.
- 25-30** Groups and Geometries, BIRS, Banff, AB.
- 26-30** 9th International Conference on Quantum Cryptography, Université de Québec à Montréal, Montreal, QC.

SEPTEMBER 2019 SEPTEMBRE

- 1-6** Workshop on Probabilistic and Extremal Combinatorics, BIRS, Banff, AB.
- 3-7** Workshop on New Trends in Polynomial Differential Systems, CRM, Montreal, QC.

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)

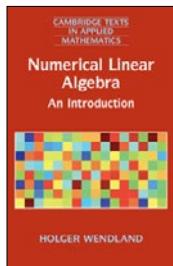
Numerical Linear Algebra: An Introduction

by Holger Wendland

Cambridge Texts in Applied Mathematics, 2018

ISBN: 978-1-316-60117-4 (Paperback, hardcover also available)

Reviewed by *Ronald D. Haynes*, Memorial University of Newfoundland



Large systems of linear algebraic equations and associated eigenvalue problems are prevalent in many areas in applied mathematics, arising naturally, for example, from the discretization of continuous problems. Holger Wendland is a professor and chair in the Department of Mathematics in the Faculty of Mathematics, Physics and Computer Sciences at the Universität Bayreuth in Germany. He is a highly cited researcher in numerical analysis and numerical linear algebra and serves on the editorial board of several prestigious journals including the SIAM Journal on Numerical Analysis and Numerical Algorithms. Professor Wendland provides a relatively concise, yet self-contained, introduction to the design, analysis, and implementation of traditional numerical algorithms to solve these linear problems on a computer. He motivates the topic with a sequence of diverse applications: interpolation, the numerical solution of boundary value problems and integral equations. Yet, the author manages, in just under 400 pages, to also introduce state of the art additional topics including preconditioning, multipole expansions, domain decomposition and applications to compressed sensing, that often do not appear in existing texts. In this way, the book finds a niche between the classic reference text "Matrix Computations" by Golub & Van Loan, which provides a somewhat terse encyclopedic treatise on the topic, and more specialized texts on iterative methods (Varga, 1962 or Saad, 2003), multigrid methods (Briggs et al., 2000 or Trottenberg, 2000) or domain decomposition methods (Toselli & Widlund, 2005 or Dolean et al., 2015).

The material could comprise a second numerical analysis course at the senior undergraduate level or an entry-level graduate course. Although a brief review of the basics of linear algebra is provided in the first chapter, students are expected to have already completed a standard undergraduate linear algebra class. As the author indicates in the preface, an essential part of a course taught with this book is the implementation of the algorithms in a programming language of the student's (or instructor's) choice. Pseudocode for all algorithms is given to assist.

Les comptes-rendus de livres présentent aux lecteurs 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 bienvenus.

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

A mathematically rigorous, formal style (Definitions, Theorems, Proofs) is kept throughout the text, even in the advanced topics and application sections, while keeping the writing relatively light. Although brief, each application section and additional topic section clearly describes the problem of interest, or the technique, providing the essential pieces which will motivate keen students (and researchers!) to follow up with dedicated introductory texts.

Each chapter ends with a set of exercises which generally are of a theoretical nature. To motivate the reader to implement the algorithms, it may have been useful to provide exercises of a numerical nature.

Most of the first six chapters of Wendland's text is not dissimilar, in scope and detail, to Trefethen and Bau's book "Numerical linear algebra" (SIAM 1997). The book under review distinguishes itself in the latter part of Chapter 6 and in Chapters 7-9 of Part III — which comprises more than half of the book's pages. The topics in these chapters are generally not seen in books at this level. The material would probably be considered graduate level, but Wendland's style makes it accessible to a more advanced undergraduate student who has worked through Parts I and II of the text.

The last section of Chapter 6 gives an introduction to multigrid methods which are fast, sometimes optimal, methods, to solve problems defined on a sequence of grids. Chapter 7 discusses three situations (fast multipole methods, hierarchical matrices and domain decomposition) which give more efficient matrix-vector products, hence potentially reducing the cost of iterative methods - even in situations where the matrix does not enjoy sparsity. The idea of improving the convergence of iterative methods is continued in Chapter 8 with a discussion of various preconditioning strategies which attempt to replace the linear system by a better conditioned, equivalent, system.

The final chapter considers underdetermined linear systems which generally have an infinite number of solutions. Compressed sensing is a technique which recovers uniqueness by imposing a sparsity constraint on the solution. Applications of this approach are numerous and include facial recognition and magnetic resonance imaging.

In summary, this text is a welcome addition to a numerical linear algebra bookshelf, either as a solid text to use in a classroom situation, or a very readable introduction for a new graduate student.

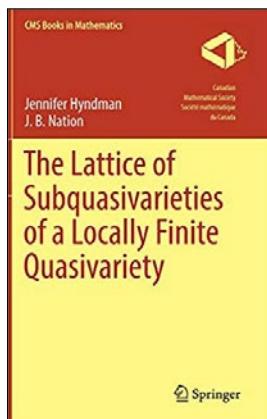
The Lattice of Subquasivarieties of a Locally Finite Quasivariety

by Jennifer Hyndman and J.B. Nation

CMS Books in Mathematics, Springer, 2018

ISBN: 978-3-319-78234-8

Reviewed by *Marina Schwidetsky*, Sobolev Institute of Mathematics, Novosibirsk, Russia



One of the most fundamental problems which defined the development of the theory of quasivarieties over several decades is a problem which was posed independently by Garrett Birkhoff and Anatolii Maltsev and which is known nowadays as the Birkhoff-Maltsev problem. The problem asks, which lattices are isomorphic to lattices of subquasivarieties of quasivarieties or, shortly, to quasivariety lattices. A complete description of lattices

isomorphic to quasivariety lattices was obtained within the class of finite distributive lattices and algebraic atomistic lattices.

For quite a long time, there was hope to obtain a similar characterization of quasivariety lattices also in the most general case. However, many results obtained within the last three decades demonstrate that quasivariety lattices have in general a highly complicated inner structure. In particular, they may be uncountable; moreover, they may contain uncountably many elements having no upper covers. For certain quasivarieties, the problem of whether a finite lattice embeds into the corresponding quasivariety lattice turns out to be undecidable. Besides that, there are particular quasivariety lattices which contain the ideal lattice of a free lattice of countable rank as a sublattice and thus are Q-universal.

These results are witness to the complexity of quasivariety lattices and their extremely rich inner structure. At the same time, they make it nearly hopeless to find a complete solution of the Birkhoff-Maltsev problem. Therefore, finding a solution of this problem even within some restricted classes of lattices is of particular interest.

In the monograph of Hyndman and Nation, the structure of lattices in the title is studied in detail with an emphasis on the role of quasicritical structures. It is well-known that the subquasivariety lattice of a locally finite quasivariety is algebraic, which means that locally finite quasivarieties become a natural subject in the investigation of quasivariety lattices. The methods developed in the monograph are applied to classical quasivarieties, such as unary algebras, lattices, Abelian groups, and unary relational structures.

Chapter 1 of the book is devoted to reviewing some basic concepts which are used throughout the text and to some fundamental facts

about classes of algebraic structures and lattices. In Chapter 2, some general results on quasivariety lattices of locally finite quasivarieties are obtained. In particular, completely join irreducible and completely meet irreducible elements of such lattices are characterized. It is also proved that the subquasivariety of a locally finite quasivariety generated by a finite structure of a finite type has finitely many lower covers; all these covers are described. Three examples are considered in the end of the chapter: certain quasivarieties generated by small modular lattices, the quasivariety of Abelian groups, and some quasivarieties of infinite type. A description of lattices belonging to the variety generated by the infinite height-two modular lattice in terms of forbidden lattices is obtained. Moreover, an equational basis of this variety consisting of a single identity is presented.

In Chapter 3, quasi-equational bases are considered. Relatively finitely based subquasivarieties of a locally finite quasivariety are described in terms of forbidden structures. Chapter 4 starts with presenting several algorithms which decide, given a finite algebra in a fixed quasivariety of finite type, if this algebra is quasicritical, determine all its quasicritical subalgebras, and find all nontrivial join covers of the subquasivariety generated by the given algebra in the corresponding quasivariety lattice. The covering relation in quasivariety lattices is also studied in this chapter.

In Chapters 5-7, techniques and algorithms developed in the previous chapters are applied to particular quasivarieties. Chapter 5 deals with quasivarieties generated by two-element unary algebras. Also, an example of such a quasivariety is found in this chapter which is Q-universal. In Chapter 6, quasivarieties of unary algebras with one unary operation are studied, while Chapter 7 is devoted to purely relational structures with only unary relations.

Appendix A reviews some basic definitions which were not explicitly used in the main exposition. It also reproduces some fundamental results on quasivariety lattices, and gives some historical comments on those results. The monograph concludes with a number of open problems.

The monograph under review contains numerous interesting new results and techniques. These results clarify the structure of quasivariety lattices and motivate future research. In spite of their complexity, the presentation is clear and not overly hard to follow. In the introduction, the authors note that most of their results which are stated for algebras are also valid for arbitrary structures of finite type. I find this precaution dispensable, as studying relational structures is no longer exotic and belongs to the everyday routine of universal algebra and model theory; this fact is also demonstrated by Chapter 7 of the monograph. This particularity of the presentation, however, does not affect the overall positive impression of the book.

I highly recommend this monograph to (universal) algebraists and logicians. I believe that some parts of its content are suitable also for graduate students.

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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Jupyter notebooks for mathematics teaching and research

Michael P. Lamoureux, University of Calgary

Introduction

Imagine a live document, hosted “in the cloud” where you can express your mathematical ideas as elegant text with beautiful formulas, descriptive diagrams and active computer code, all tightly integrated to create interactive animations, graphics, and data analysis to illustrate your thoughts. Then imagine extending this tool into a sharable resource that you can exchange with fellow teachers, students, and researchers using free, open source resources online.

This is the idea behind *Jupyter Notebooks* ([Jupyter.org](https://jupyter.org) [9]), created in 2014 by Fernando Perez of the University of California, Berkeley. Such *notebooks* are not physical devices, but instead they are just simple computer files stored in plain text, that become live, interactive documents which you can read, create, and share through any standard web browser using a Jupyter server.

Jupyter notebooks and related services have been widely adopted in the computing industry. Some notable examples include Amazon’s **SageMaker** notebooks, Google’s **Colaboratory**, Microsoft’s **Azure** notebooks, and Jupyter. It even appears in popular media where ground-breaking scientific discoveries are released in the form of a Jupyter notebook, such as the first detection of gravitational waves from black holes (Puget [12]). The name *Jupyter* is derived from three key computer languages initially supported by the project: Julia, Python and R (Ju-Pyt-eR). Notably, Jupyter notebooks now support a plethora of computing languages, including favourites such as Matlab®, Scala, Haskell, and more.

In the last few years, educators have recognized that these notebooks form an excellent tool for delivering course content to their students. Some schools and universities have adopted these notebooks in a big way for course delivery. For instance, the University of California at Berkeley runs its Data Science course (Data-8 [5]) for all undergraduates on the Jupyter platform. The textbook is hosted online, and works seamlessly with Jupyter notebooks to deliver the material. In Canada, the Syzygy and

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 bienvenus.

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Callysto projects give Canadian academics and teachers easy access to the Jupyter experience. More on this below.

This article is inspired by my own experiences using Jupyter notebooks for my classes in mathematical analysis and modeling at the Universities of British Columbia and Calgary, and with the development of the Syzygy and Callysto services.

What is a Jupyter Notebook?

A Jupyter notebook is simply a document that you open in a web browser. When you create a new notebook, a document appears in your web browser as shown in Figure 1. Each document includes a menu bar and tool bar with familiar items such as **File**, **Edit**, **View**, and some information about the document, indicating in this instance that this is a **Python 3** document with the name **Untitled1**.

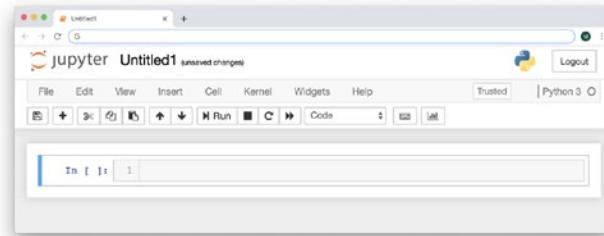


Figure 1: An empty notebook.

Underneath the tool bar is a rectangular box called a *cell*, marked with the label *In*[]. A notebook is made up of many cells, where you enter text, *LaTeX* for mathematical formulas, images and graphics, as well as computer code. Once you enter your text and other material, the notebook displays it in a form that looks a lot like a regular mathematical textbook, as shown in Figure 2. This is a sample of lecture notes from an applied math course at the University of Calgary.

Where notebooks really shine, though, is when we include live, editable computer code that demonstrate deeper mathematical concepts. For instance, in Figure 3 we see a single line of code implementing the conformal map in the complex plane, given by the formula

$$z \mapsto \frac{z - 0.1}{0.1z - 1}.$$

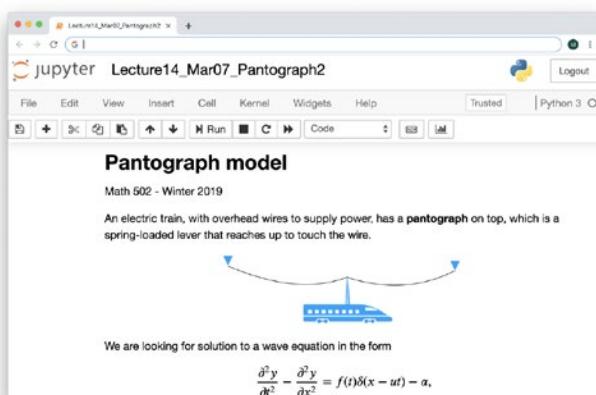


Figure 2: Top of a notebook as lecture notes.

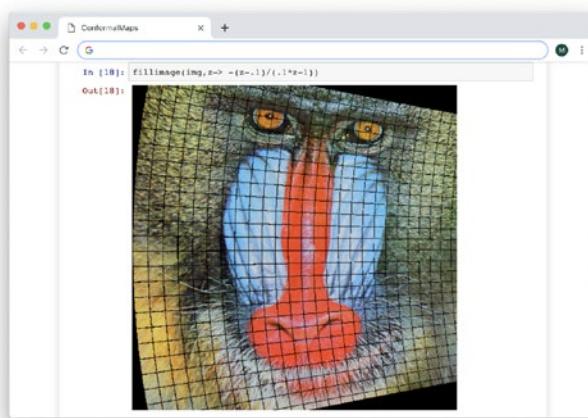


Figure 3: Live code in a notebook, implementing a conformal map.

The result is the transformed image of the well-known Mandrill photographic image under this map. The grid lines are included here to demonstrate the interesting mathematical property of angle-preservation in conformal maps. Interestingly, the one line of code (labeled In[18]) is easy enough to read that a student can easily modify it, to implement other conformal maps.

As another example, in Figure 4 we see a plot of a ball rolling around another ball. This is in fact an animation of the solution to a system of differential equations which models a ball rolling along another ball, under the influence of gravity. The animation is live, with mathematical code backing it up to give a real-time simulation of a physical ball rolling on top of another. In the figure, you can see a glimpse of the code, as well as features on the diagram such as markings to indicate the rotation angles of the balls. It is unfortunate that this "old fashioned" paper document you are currently reading cannot replicate the live animation itself!

Jupyter Hubs to Support Notebooks

Jupyter notebooks are just plain text files. To become live documents with proper typesetting, graphics, and interactive code, they need to "run" on a special server known as a Jupyter Hub. Typically, the Hub runs as a virtual computing machine hosted online "in the cloud,"

giving each user access to their own, personal compute engine and online storage to host their files and notebooks.

For researchers and educators in Canada, there are two convenient, nation-wide Jupyter services provided by a federally-funded collaboration between **Compute Canada** [3], **Cybera Inc.** [4], and the Pacific Institute for the Mathematical Sciences [11]. The first, called **Callysto.ca** [1], supports teachers and students in grades K-12, with a convenient login over the internet via their federated school ID or Google credentials. The second, **Syzygy.ca** [14], provides a separate online service for students and faculty at Canadian universities, providing them with cloud-hosted Jupyter tools using a single sign-on with their university login credentials. Both of these services are hosted on Canadian-based compute infrastructure, in order to meet provincial privacy requirements for students in grades K-12 and university.

If you are feeling inquisitive, you can leap right in and log onto these services at <https://hub.callysto.ca> or <https://pims.syzygy.ca>. More details about online training for these services are given in the sections below.

For the more technically inclined, it is not too difficult to install a Jupyter hub on one's own desktop computer or on a commercial server. Details are at the website for [Jupyter.org](https://jupyter.org) [9]. For the typical user in schools, the ready-made services of Syzygy and Callysto are better solutions.

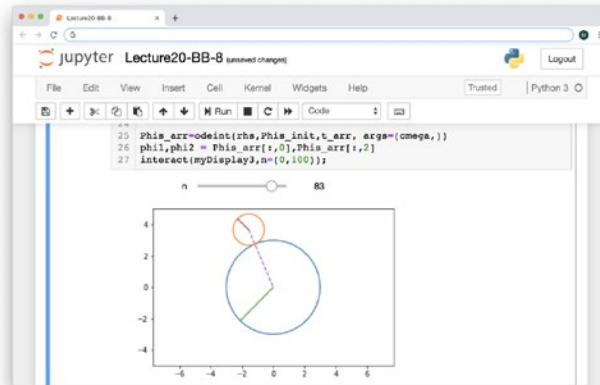


Figure 4: Animating a differential equation simulation.

The Callysto and Syzygy Projects

With the push to get computational thinking into the curriculum for students in grades K-12, as well as providing the best tools to university educators and researchers, the Callysto and Syzygy projects were created to both provide the technical service as well as the training and content to support these goals.

To demonstrate how Jupyter notebooks can be used in the classroom, the team of creators in the Callysto Project have developed a collection of curriculum-based notebooks, working jointly with teachers from Canadian school system. To highlight a sample notebook from the project, Figure 5 shows an interesting example using statistical tools for textual analysis of Shakespeare.

In this notebook, students can download the text for any work of Shakespeare using the online Gutenberg resource, then run code to count nouns, phrases, and other key indicators to begin an analysis of the text. Other notebooks explore topics in geometry, chemistry, physics and data science, often using live data from online resources such as Statistics Canada and other government webpages.

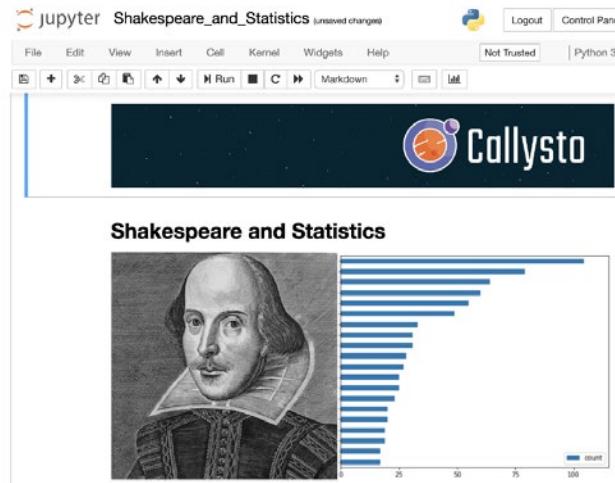


Figure 5: A notebook for textual analysis of Shakespeare.

The Callysto project is also developing an online OpenEdX course on how to use Jupyter notebooks in the classroom, which is available to teachers across all disciplines.

The Syzygy service is used by university researchers and instructors to present materials in courses and share research results. It is also used by students to prepare assignments and turn in projects that require proper presentations with excellent text, rich graphics and even live code or data analysis to demonstrate their ideas.

For training, the Syzygy user manual (Lamoureux [10]), is available online at: <http://www.syzygy.ca>. In addition to the basic tutorials on how to use a Jupyter notebook and the Syzygy server, the manual shows a listing of twenty or so Canadian universities that provide single sign-on service to Syzygy using university credentials. As noted above, this is a convenient way to get an entire university class on-line in a hassle-free manner.

Going further

Across the web, there are tens of thousands of interesting Jupyter notebooks covering a wide variety of technical topics, all of which can run on the Callysto and Syzygy servers. A good place to start is the Github gallery [6] of notebooks listed in the references below. Many are viewed as simple static documents, other can be loaded as a live document using a single click on the appropriate link in the

gallery. It is a quick way to see the rich assortment of material that can be presented in the Jupyter format.

If you are wanting to just play around, a great way to get started with Jupyter notebooks is to try them out on the free server provided by the Jupyter project, at <https://jupyter.org/try>. Here you can open a few notebooks, try out some ideas and get a feel for the system. However, you won't be able to save your work.

For serious work, you will likely want to create your own account on the cloud that you can access online from any web browser, with your creations safely stored on a reliable remote server. Callysto and Syzygy are great places to start for those in academia, and are well-supported by trusted organizations in the non-profit sphere that many of us are already familiar with. There are many “for-pay” options for those doing their research and training in the commercial world.

As our daily work moves more and more to the cloud, these Jupyter notebooks are a key component in our technical toolbox for teaching and research.

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<http://data8.org>
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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, suggestions, and submissions are welcome.

Patrick Ingram, York University (notes-research@cms.math.ca)

Rigidity of circle maps with a break point

Elio Mazzeo, Assistant Professor at Trent University

One of the most interesting type of maps in one dimensional dynamics are the orientation preserving circle homeomorphisms, which we simply call *circle maps*, and one of which we denote by T . Their study was begun by Poincaré, who introduced the important notion of the *rotation number* $P \in [0, 1)$ for such a map. The rotation number measures the amount by which the map T moves a point asymptotically on average. It characterizes the combinatorial structure of the orbits of T .

A natural class of circle maps are the *circle maps with a break point*. They are $C^{2+\alpha}$ differentiable (with $\alpha > 0$) everywhere except at a single point x_0 where there is a jump in the first derivative. One defines the *size of the break*, c , as the square root of the ratio of the left and right derivative of T at the break point x_0 . With the parameter $c \neq 1$, circle maps with a break point are a 1-parameter extension of the family of circle diffeomorphisms. Circle maps with break points are also examples of generalized interval exchange transformations.

In mathematics, *rigidity* often refers to proving that two objects which are in a certain sense similar, must share a stronger similarity than the one originally known to hold. We study the rigidity problem for circle maps with a break point. That is, given two circle maps with a break point that share the same irrational rotation number ρ , that are necessarily topologically conjugate and have the same size of the break c , we would like to know whether they are in fact C^1 smoothly conjugate to each other. We are also interested in knowing for which class of rotation numbers does the C^1 rigidity hold. The term *robust rigidity* refers to the instance in which C^1 rigidity holds for all irrational rotation numbers.

To prove rigidity one uses the *renormalization method*, which is based on the idea that in order to study the possibly complicated dynamics of a map T , it is simpler to examine large iterates of our map on a small scale, based on the concept of the first return map or a more general return map.

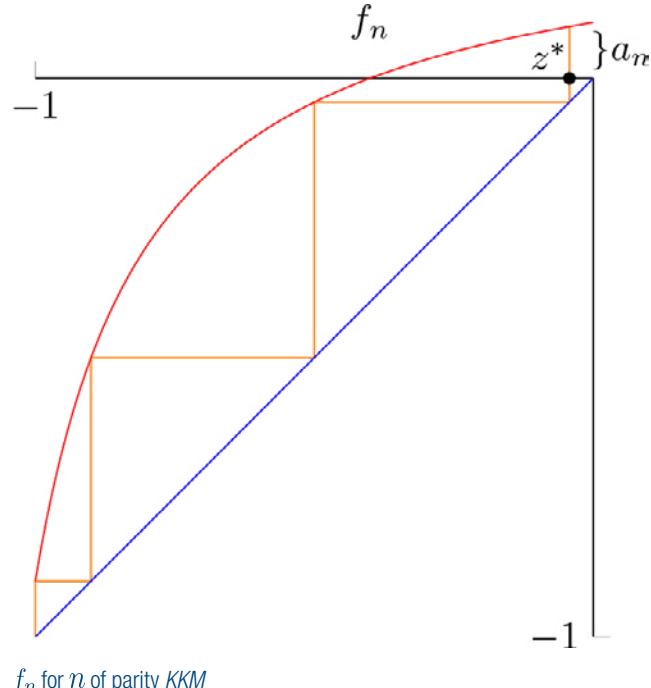
Let us introduce the renormalization pair for a circle map. Let us expand the irrational rotation number ρ into a continued fraction $[k_1, k_2, k_3, \dots]$. Let $n \geq 1$ and consider the n -th convergents $p_n/q_n = [k_1, k_2, k_3, \dots, k_n]$. In particular, we have the recurrence relation, $q_{n+1} = k_{n+1} \cdot q_n + q_{n-1}$. Consider the marked point on the circle x_0 and its i -th iterate $x_i := T^i(x_0)$.

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, suggestions et propositions sont les bienvenus.

Patrick Ingram, York University (notes-recherche@smc.math.ca)

Let $\Delta_0^{(n)}$ be the closed interval with endpoints x_0 and x_{q_n} , and let the ‘core interval’ of level n be $\bar{\Delta}_0^{(n-1)} := \Delta_0^{(n-1)} \cup \Delta_0^{(n)}$. In the case of circle maps, the first return map of T to the core interval is a piecewise-defined map with two pieces (T^{q_n}, T^{q_n-1}) respectively defined on $(\Delta_0^{(n-1)}, \Delta_0^{(n)})$. Since $\Delta_0^{(n-1)} \rightarrow 0$ as $n \rightarrow \infty$, we rescale $\Delta_0^{(n-1)}$ to be of unit length at each level n by an affine change of variables that sends x_{q_n-1} to -1 and x_0 to 0 . The resulting renormalized pair, the first component of which we denote by f_n , depends asymptotically on the essential features of our original map T , namely its rotation number as well as the local structure of its singular points.

For circle maps with a break point, Khanin and Vul [3] showed that the renormalized map f_n is exponentially close to an F_n from an explicit 2-parameter family of fractional linear transformation (FLT) pairs (F_n, G_n) with the two parameters being $a_n := f_n(0)$, $b_n = -f_n(-1)$. Depending on whether $c < 1$ or $c > 1$ and also depending on the parity of n , there are two cases for what the renormalized map f_n asymptotically looks like. We refer to the case in which f_n is concave down as parity KKM.



f_n for n of parity KKM

An essential *distortion-type estimate* when working on the core interval $\bar{\Delta}_0^{(n-1)}$ is to show that with the renormalized maps f_n and \tilde{f}_n , and the intervals formed by iterating the maps starting with -1 , the ratio of the lengths of corresponding intervals

is exponentially close to 1 in n uniformly in $1 \leq j \leq k_{n+1}$. Notice that $k_{n+1} + 1$ is the number of iterates required to cross over to the positive side of the horizontal axis. That is, in Figure (1), $z^* = f_n^{j^*}(-1)$, where $j^* = k_{n+1}$. During the iterative process involved, extending this distortion-type estimate is more difficult and at times impossible, the greater the growth rate of k_{n+1} .

In [2], Khanin and Teplinsky proved that C^1 rigidity holds for circle maps with a break point that have a rotation number of the so-called half-bounded type, where k_{n+1} is bounded for n of parity KKM. In [1], we show that for the case of general circle maps with a break point, C^1 rigidity holds generically, namely for a Lebesgue full measure set of rotation numbers that include very non-diophantine rotation numbers. Moreover, in (4) it is also shown that for the special class of the attracting family of fractional linear transformation (FLT) pairs, C^1 rigidity holds *robustly*, that is for all irrational rotation numbers.

In [4], a sufficient condition for C^1 rigidity of circle maps with a break point is given, the so-called '*derivatives close condition*'. In the case when n is of parity KKM, and for $k_{n+1} \rightarrow \infty$ (and thus $a_n \rightarrow 0$), it requires that for T and \tilde{T} the corresponding renormalized maps

f_n and \tilde{f}_n have derivatives at each endpoint of the interval $[-1, 0]$ close enough to each other as compared to the growth rate of k_{n+1} . In particular, in general it was necessary to limit the growth rate of k_{n+1} to be at most exponentially large in n . This '*derivatives close condition*' not being satisfied in general is the obstruction to C^1 *robust* rigidity for general circle maps with a break point.

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cms.math.ca | smc.math.ca



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)

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

Les articles de la SCHPM présentent des travaux de recherche en histoire et en philosophie des mathématiques à la communauté mathématique élargie. Les auteurs sont membres de la Société canadienne d'histoire et de philosophie des mathématiques (SCHPM). Vos commentaires et suggestions sont le bienvenue; ils peuvent être adressées à l'une des co-rédacteurs:

Amy Ackerberg-Hastings, Chercheuse indépendante

(aackerbe@verizon.net)

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

“But [the historian’s] particular business lies, not with this bare and general similarity, but with the detailed dissimilarity of past and present. He is concerned with the past as past, and with each moment of the past in so far as it is unlike any other moment.” – Michael Oakeshott (1933, 106)

Past, Present, and Anachronism in the Historiography of Mathematics

Craig Fraser, University of Toronto

Andrew Schroter, Branksome Hall Senior School (Toronto)

There is more than one way to view the mathematics of the past. Ivor Grattan-Guinness (2004) identifies a disjunction between heritage (our tracking of a particular concept’s journey along the “royal road” from the past to the present) and history (our attempt to explain why a certain mathematical development happened). The “heritage” approach evaluates past mathematics in light of recent theories, looking for similarities that reveal the gradual unveiling of a mathematical concept. Conversely, “history” instinctively looks for differences and discontinuities.

In 1975 a lively debate on the study of ancient mathematics opened with the publication of Sabetai Unguru’s “On the need to rewrite the history of Greek mathematics.” Unguru addressed what he saw as the anachronism implicit in the then-standard view of Euclid’s *Elements Book II* as a form of geometric algebra. The propositions that Euclid proved may be read as geometric versions of algebraic identities, and the central result is the division of a line in the golden section, which may be viewed as equivalent to the solution of a quadratic equation. Nonetheless, Unguru pointed out, there are no algebraic variables or symbols for operations, and the very word “algebra” is of Arabic origin and first appears in Islamic mathematical science over a thousand years after Euclid.

More generally Unguru called for a new and historically sensitive interpretation of the entire corpus of ancient Greek mathematics. Unguru’s thesis, which was novel and provocative at the time, was gradually accepted by historical researchers and became something

of the received view in the field. It was extended beyond ancient mathematics to medieval and early modern mathematics, and even to the whole range of developments in mathematics since 1700.

The received view, though widely held, is by no means universally endorsed by historians of mathematics. Izabella G. Bashmakova (1993) has written on the history of Diophantine analysis and argues that modern algebraic geometry is required to fully understand the development of this subject over the past two thousand years. In 2014 Victor Blåsjö, a young historian of mathematics, published “A critique of the modern consensus in the historiography of mathematics,” in which he advocates for a form of rational history where modern notions play a meaningful role in the interpretation of past mathematics.

An indication of current interest in the historiography of mathematics is evident in an international conference that was held in April 2017 at Caltech: “Anachronism(s) in the History of Mathematics: The Seventh Biennial Bacon Conference.” The conference was organized by Niccolò Guicciardini, Professor at the University of Bergamo and recipient of the 2018 Francis Bacon Award in the History and Philosophy of Science and Technology. The subject of the conference was expressed as follows: “Anachronism is often declared the greatest failure, almost a moral sin, a historian can commit. Yet, some have spoken in favor of anachronism, considering it either as an inevitable, or even as a desirable feature of an historical work. The purpose of this two-day international conference is to reflect on the uses and abuses of anachronism in the historical study of the mathematical sciences.”

In some preliminary remarks Guicciardini called attention to one of the earliest descriptions of historical anachronism, by Jean Leclerc in his *Ars Critica* of 1697. He also referred to Quentin Skinner’s 1969 essay in *History and Theory*, titled “Meaning and Understanding in the History of Ideas,” where Skinner observes (p. 9), “We should not credit a writer with a meaning he could not have intended to convey,

since that meaning was not available to him.” In his Bacon address Guicciardini discussed the case of Newton’s scientific writings and those of his contemporaries, and the narrative tension involved in rendering them comprehensible to a modern reader without compromising their historical character.

In our own contribution to the proceedings of the Caltech meeting we examine some of Leonhard Euler’s contributions to mathematics and their later interpretation by mathematicians and historians of mathematics. The two subjects considered are Euler’s derivation in the 1740s of the equations of the calculus of variations and his work in the 1750s on divergent series. Certain concepts occupy a fundamental place in the modern subject, but do not appear in the work of either Euler or his contemporaries. In the case of variational calculus there is the concept of the invariance of the variational equations; in the case of infinite series there is the concept of summability. While both concepts are a product of research since the later part of the nineteenth century, modern historical commentators such as Constantin Carathéodory, Herman Goldstine and Morris Kline have discerned the presence of intuitions or embryonic ideas of invariance or summability in Euler’s writings. We conclude that claims that Euler grasped invariance, or was a summabilist, are anachronistic. More broadly, we argue that mathematicians and historians may draw on heritage for didactic purposes—say, to teach about convergence. However, for one who takes our modern concepts and methods to be correct, it is easy to slip from a view that Euler ought to have used them to a claim that he did somehow use them. It is then that anachronism reaches the end of its utility: a more historical lens is required to help us see the “past as past” and understand Euler’s achievements in their own context.

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2019 CMS Winter Meeting

December 6-9, 2019

Deadline: July 31, 2019

The Chelsea Hotel, Toronto, Ontario

CALL FOR SESSIONS

The Canadian Mathematical Society (CMS) welcomes and invites session proposals for the 2019 CMS winter meeting in Toronto from December 6-9.

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 7, 8, and 9. The meeting schedule will accommodate 9 speakers per full day, and 4 or 5 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. 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 **July 31, 2019**.

Scientific Directors:

Patrick Ingram (York University) pingram@yorku.ca

Jane Heffernan (York University) jmheffer@yorku.ca



Réunion d'hiver de la SMC 2019

6-9 décembre 2019

Date limite : 31 juillet 2019

The Chelsea Hotel, Toronto, Ontario

APPEL DE PROPOSITIONS DE SESSIONS

La Société mathématique du Canada (SMC) invite la communauté mathématique à proposer des sessions pour sa Réunion d'hiver 2019, qui se tiendra à Toronto du 6 au 9 décembre.

Ces propositions doivent comprendre : 1) le nom, l'affiliation et les personnes à contacter pour tous les coorganisateurs de 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 leur affiliation et leur intention de participer, ainsi que le nombre de conférenciers prévus.

Les sessions se dérouleront les 7, 8, et 9 décembre. Le format de la Réunion peut accommoder 9 conférenciers par journée pleine, et 4 ou 5 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 aux directeurs scientifiques. Nous vous invitons, dans votre proposition, à porter attention à la diversité des personnes invitées et des organisateurs de la session proposée.

Ces demandes doivent nous parvenir au plus tard le **31 juillet 2019**.

Directeurs scientifiques :

Patrick Ingram (York University) pingram@yorku.ca

Jane Heffernan (York University) jmheffer@yorku.ca



■ CMS 75th Anniversary Meeting

The Canadian Mathematical Society (CMS) welcomes and invites proposals for scientific sessions for the 2020 CMS Summer meeting in Ottawa from June 5-8, 2020.

Proposals should include (1) names, affiliations, and contact information for two (or more) session co-organizers, (2) a title and brief description of the focus and purpose of the session, (3) a preliminary list of potential speakers with their affiliations, along with a total number of expected speakers. Potential organizers are encouraged to consider diversity in their selection of session invitees.

Sessions will take place June 5-8. They will be advertised in the CMS Notes, on the CMS website and in the AMS Notices. Speakers will be requested to submit abstracts, which will be published on the website and in the meeting program.

Those wishing to organize a session should send a proposal to the 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

Proposals should be submitted by **September 30, 2019**.



■ Réunion du 75^e anniversaire de la SMC

La Société mathématique du Canada (SMC) sollicite des propositions de sessions scientifiques pour sa Réunion d'été 2020, qui se tiendra à Ottawa du 5 au 8 juin 2020.

Les propositions doivent inclure (1) les noms, affiliations et coordonnées d'au moins deux coorganisateurs, (2) un titre et une brève description du sujet et du but de la session, (3) une liste préliminaire des conférenciers potentiels avec leurs affiliations, ainsi que le nombre de conférenciers attendus. Les organisateurs potentiels sont invités à prendre en compte la diversité dans leur sélection d'invités.

Les sessions auront lieu du 5 au 8 juin. Toutes les sessions seront annoncées dans les Notes de la SMC, sur le site web de la SMC et dans les AMS Notices. 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 aux directeurs scientifiques :

Ailana Fraser (Université de la Colombie-Britannique) afraser@math.ubc.ca

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

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

La date limite pour présenter une proposition est le **30 septembre 2019**.



CMS Research Prizes

The CMS Research Committee is inviting nominations for three prize lectureships. These prize lectureships are intended to recognize members of the Canadian mathematical community.

The **Coxeter-James Prize** Lectureship recognizes young mathematicians who have made outstanding contributions to mathematical research. The recipient shall be a member of the Canadian mathematical community. Nominations may be made up to ten years from the candidate's Ph.D. A nomination can be updated and will remain active for a second year unless the original nomination is made in the tenth year from the candidate's Ph.D. For more information, visit: <https://cms.math.ca/Prizes/cj-nom>

The **Jeffery-Williams Prize** Lectureship recognizes mathematicians who have made outstanding contributions to mathematical research. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for three years. For more information: <https://cms.math.ca/Prizes/jw-nom>

The **Krieger-Nelson Prize** Lectureship recognizes outstanding research by a female mathematician. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for two years. For more information: <https://cms.math.ca/Prizes/kn-nom>

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 for research in the mathematical sciences regardless of race, gender, ethnicity or sexual orientation. A candidate can be nominated for more than one research prize in the applicable categories; several candidates from the same institution can be nominated for the same research prize.

CMS research prizes are gender-neutral, except for the Krieger-Nelson prize, which is awarded to women only. Nominations of eligible women for the general research prizes in addition to the Krieger-Nelson Prize are strongly encouraged.

The deadline for nominations, including at least three letters of reference, is **September 30, 2019**. Nomination letters should list the chosen referees and include a recent curriculum vitae for the nominee. Some arms-length referees are strongly encouraged. Nominations and the reference letters from the chosen referees should be submitted electronically, preferably in PDF format, to the corresponding email address and **no later than September 30, 2019**:

Coxeter-James: cjprize@cms.math.ca

Jeffery-Williams: jwprize@cms.math.ca

Krieger-Nelson: knprize@cms.math.ca

Prix de recherche de la SMC

Le Comité de recherche de la SMC lance un appel de mises en candidatures pour trois de ses prix de conférence. Ces prix ont tous pour objectif de souligner l'excellence de membres de la communauté mathématique canadienne.

Le **Prix Coxeter-James** rend hommage aux jeunes mathématiciens qui se sont distingués par l'excellence de leur contribution à la recherche mathématique. Cette personne doit être membre de la communauté mathématique canadienne. Les candidats sont admissibles jusqu'à dix ans après l'obtention de leur doctorat. Toute mise en candidature est modifiable et demeurera active l'année suivante, à moins que la mise en candidature originale ait été faite la 10 année suivant l'obtention du doctorat. Pour les renseignements, voir : <https://cms.math.ca/Prix/cj-nom>

Le **Prix Jeffery-Williams** rend hommage aux mathématiciens ayant fait une contribution exceptionnelle à la recherche mathématique. Cette personne doit être membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant trois ans. Pour les renseignements, voir : <https://cms.math.ca/Prix/jw-nom>

Le **Prix Krieger-Nelson** rend hommage aux mathématiciennes qui se sont distinguées par l'excellence de leur contribution à la recherche mathématique. La lauréate doit être membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant deux ans. Pour les renseignements, voir : <https://cms.math.ca/Prix/kn-nom>

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 exceptionnels pour la recherche dans les sciences mathématiques sans distinction de race, de genre, d'appartenance ethnique ou d'orientation sexuelle. Une personne peut être mise en candidature pour plus d'un prix de recherche dans les catégories applicables ; plusieurs candidats d'un même institut peuvent être nommés pour le même prix de recherche.

Les prix de recherche de la SMC sont non sexistes, à l'exception du prix Krieger-Nelson, qui est décerné uniquement aux femmes. Les candidatures de femmes éligibles pour les prix de recherche généraux en plus du prix Krieger-Nelson sont fortement encouragées.

La date limite pour déposer une candidature, qui comprendra au moins trois lettres de référence, est **le 30 septembre 2019**. Le dossier de candidature doit comprendre le nom des personnes données à titre de référence ainsi qu'un curriculum vitae récent du candidat ou de la candidate. Veuillez faire parvenir les mises en candidature et lettres de référence par voie électronique, de préférence en format PDF, avant la date limite, à l'adresse électronique correspondante et **au plus tard le 30 septembre 2019** :

Coxeter-James : prixcj@smc.math.ca

Jeffery-Williams : prixjw@smc.math.ca

Krieger-Nelson : prixkn@smc.math.ca

2020 Excellence in Teaching Award

The CMS Excellence in Teaching Award Selection Committee invites nominations for the *2020 Excellence in Teaching Award*.

The Excellence in Teaching Award focuses on the recipient's proven excellence as a teacher at the undergraduate level, including at universities, colleges and cégeps, as exemplified by unusual effectiveness in the classroom and/or commitment and dedication to teaching and to students. The dossier should provide evidence of the effectiveness and impact of the nominee's teaching. The prize recognizes sustained and distinguished contributions in teaching at the post-secondary undergraduate level at a Canadian institution. Only full-time teachers or professors who have been at their institution for at least five years will be considered. The nomination will remain active for three years, with a possibility to update.

The 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.

Nomination letters, *including at least three letters of reference*, should list the chosen referees and include a recent curriculum vitae for the nominee, if available.

Nominations and reference letters should be submitted electronically, preferably in PDF format, to: etaward@cms.math.ca no later than the deadline of **November 15, 2019**.

Prix d'excellence en enseignement 2020

La Comité de sélection du Prix d'excellence en enseignement de la SMC sollicite des mises en candidature pour le *Prix d'excellence en enseignement 2020*.

Le Prix d'excellence en enseignement de la SMC récompense l'excellence reconnue d'un enseignant ou d'un professeur de niveau postsecondaire (universités, collèges et cégeps), telle qu'illustrée par son efficacité exceptionnelle en classe et/ou son engagement et son dévouement envers l'enseignement et les étudiants. Le dossier de candidature doit montrer l'efficacité et les effets de l'enseignement du candidat ou de la candidate. Ce prix récompense des contributions exceptionnelles et soutenues en enseignement collégial et de premier cycle universitaire dans un établissement canadien. Seules les candidatures d'enseignants et de professeurs à temps plein qui travaillent dans le même établissement depuis au moins cinq ans seront retenues. Une candidature peut être mise à jour et demeure active pendant 3 ans.

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 exceptionnels sans distinction de race, de genre, d'appartenance ethnique ou d'orientation sexuelle.

Le dossier de candidature, *comportant au moins trois lettres de référence*, doit comprendre le nom des personnes données à titre de référence ainsi qu'un curriculum vitae récent du candidat ou de la candidate, dans la mesure du possible.

Veuillez faire parvenir les mises en candidature et lettres de référence par voie électronique, de préférence en format PDF, à : prixee@smc.math.ca avant la date limite du **15 novembre 2019**.

Did you know?

The CMS with the University of Regina will be offering complimentary childcare for registered participants during the 2019 CMS Summer Meeting in Regina?

Register Now!

Saviez-vous que ?

La SMC avec l'Université de Regina offrira un service de garde pendant la Réunion d'été 2019 à Regina.

Inscrivez-vous maintenant!



With Two Bronze Medals and Two Honourable Mentions: Canadian All Girls Math Team Shines on the International Stage



The Canadian Mathematical Society is pleased to announce that its second team to compete in the European Girls' Mathematical Olympiad (EGMO) has returned from Ukraine, medals in hand. Canadian EGMO Team earned two Bronze Medals and two Honourable Mentions.

The EGMO competition got started in 2012 when it was first written in Cambridge, UK and has since grown to include more than 50 countries. Participation in the EGMO is by invitation only. Each student competes individually to solve six questions, in a competition lasting two days, four and a half hours each day. The Girls Math Team Canada was selected largely based on the results of the 2018 Canadian Open Mathematics Challenge (COMC) written in November, as well as a Team Selection Test that was sent to the top 15 girls from the 2018 COMC.

The 2019 team was led by CMS Mathematical Competitions Chair, Professor Dorette Pronk (Dalhousie) and Deputy Leader Sarah Sun (GoldSpot Discoveries Inc.). They served as Leader and Deputy Leader respectively for 2018 EGMO Math Team Canada in Italy.

The Canadian EGMO Team was trained at the Fields Institute for Research in Mathematical Sciences, in Toronto from February 22–24. In addition to Professor Dorette Pronk and Sarah Sun, James Rickards (McGill) assisted with the training.

Canada's presence at the European Girls' Mathematical Olympiad was made possible in large part due to the financial support of the University of Waterloo's Faculty of Mathematics for which the Society is very grateful. The Society would also like to acknowledge the organizers of the Winter Training Camp at York and The Fields Institute for hosting the Girls' training camp. The CMS is also thankful for the support of the Actuarial Foundation of Canada, University of Regina, NSERC PromoScience, the Samuel Beatty Fund and many individual donations. This support enabled the Society to send a Canadian team to this important event and celebrate the achievement of girls in STEM.

Canada's Team consisted of:

- Siyu (Elaine) Liu, Bronze Medalist – Appleby College, Oakville, ON
- Anna Krokhine, Bronze Medalist – University of Toronto Schools, Toronto, ON
- Katie Forbes, Honourable Mention – Old Scona Academic High School, Edmonton, AB
- Zixian (Ruby) Wei, Honourable Mention – Colonel Gray SR. H.S., Charlottetown, PE



Avec deux médailles de bronze et deux mentions honorables : notre équipe de filles brille sur la scène mathématique internationale



La Société mathématique du Canada (SMC) est fière d'annoncer que la deuxième équipe canadienne à participer aux Olympiades européennes de mathématiques pour filles (OEMF) vient de rentrer de l'Ukraine avec deux médailles de bronze et deux mentions honorables.

Ce concours, qui a vu le jour en 2012 à Cambridge, au Royaume-Uni, accueille maintenant des participantes de plus de 50 pays. Seules les élèves invitées peuvent participer aux OEMF. Chaque élève doit répondre individuellement à six questions dans le cadre d'un concours de deux jours, à raison de quatre heures et demie par jour. Les jeunes filles qui ont représenté le Canada ont été sélectionnées en grande partie en fonction de leurs résultats du Défi ouvert canadien de mathématiques (DOCM) 2018 auquel elles ont participé en novembre, ainsi que d'un test de sélection envoyé à celles qui ont obtenu les 15 meilleurs résultats au DOCM 2018.

L'équipe de 2019 était dirigée par la présidente du Comité des concours mathématiques de la SMC, la professeure Dorette Pronk (Dalhousie), et la chef d'équipe adjointe, Sarah Sun (GoldSpot Discoveries Inc.). Elles étaient respectivement chef d'équipe et chef d'équipe adjointe de l'équipe du Canada l'année dernière en Italie.

L'équipe canadienne aux OEMF a participé à un camp d'entraînement à l'Institut Fields de recherche en sciences mathématiques, à Toronto, du 22 au 24 février. En plus de mesdames Pronk et Sun, James Rickards (McGill) a contribué à la préparation des participantes.

La présence du Canada aux Olympiades européennes des mathématiques pour filles a été rendue possible en grande partie grâce au soutien financier de la Faculté de mathématiques de l'Université de Waterloo, envers qui la SMC est très reconnaissante. La Société aimerait également remercier les organisateurs du camp d'entraînement hivernal de l'Université York, de même que l'Institut Fields d'avoir organisé le camp d'entraînement de l'équipe. La SMC remercie aussi de leur appui la Fondation actuarielle du Canada, l'Université de Regina, le programme PromoScience du CRSNG, le Fonds Samuel Beatty et les dons individuels. Cet appui a permis à la Société d'envoyer une équipe canadienne à cet événement important et de souligner la performance de filles dans les disciplines des STIM.

Voici la composition de l'équipe canadienne :

- Siyu (Elaine) Liu, médaille de bronze – Appleby College, Oakville, Ont.
- Anna Krokhine, médaille de bronze – University of Toronto Schools, Toronto, Ont.
- Katie Forbes, mention honorable – Old Scona Academic High School, Edmonton, Alb.
- Zixian (Ruby) Wei, mention honorable – Colonel Gray SR. HS, Charlottetown, Î.-P.-É.

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