CMS NOTES de la SMC

FROM THE EXECUTIVE DIRECTOR'S DESK

Johan Rudnick, ***Canadian Mathematical Society***

IN THIS ISSUE
DANS CE NUMÉRO

NOT NECESSARILY AN EASY ACT TO FOLLOW

The new *Canada Not-for-Profit Corporations Act* came into force on October 17, 2011, and charities like the CMS will have until October 17, 2014 to comply with new bylaw and other operating and filing requirements. In approaching the transition to the new *Act* charities can choose to either adjust to the *Act* as necessary or essentially be recast in light of the *Act*. As a mature, substantive, national organization, the CMS appears to already comply with much of what the new *Act* brings into force. However, after twelve adjustments to the original bylaws that were crafted some 30+ years ago, it just might be an opportune time for the CMS to think about getting some new bylaws.

CMS Bylaws

The new Act provides charities with broad default bylaws – essentially predefined bylaws. Using the default provisions of the *Act*, organizations can entertain much simpler, even minimalist bylaws. The new *Act* also allows for bylaws to simply be filed and no longer requires review and approval by Industry Canada. While the CMS bylaws work to one degree or another, some of the direction is dated and presents some operational challenges. Recast bylaws would afford the CMS the opportunity to build anew on current best practices and technologies while at the same time introducing operational flexibility.

The Business of the CMS

Under the new *Act*, charities like the CMS are afforded the same rights as a business corporation and can engage in both non-commercial and commercial activities. The extent to which a CMS activity such as publishing journals can be moved into a commercial activity has yet to be considered. It should be noted, however, that while the *Act* may allow for commercial activity, such activity may run afoul of tax regulations for charities and would therefore be constrained by those requirements.

The Duties of CMS Directors and Officers

The new *Act* provides CMS directors and officers with the same statutory duties of care and loyalty that those of a business have and the *Act* also introduces conflict of interest compliance requirements. Given current CMS practices and the recently introduced CMS Conflict of Interest policy, compliance with duties and conflict of interest requirements should not be problematic for the CMS.

The CMS Board

The new *Act* stipulates a minimum of three directors for a Board of Directors – the CMS has 33 voting members supplemented by other attendees. By way of comparison, the CMS Board is significantly larger than that of the Canadian Medical Association or Ottawa City Council and is almost double the size of the NSERC Council. The new *Act* also permits board meetings to be conducted by conference call and to transact business by written resolution. Given the size of the CMS Board, effective conference call meetings are difficult to envision. Under existing bylaws, securing approval of written (electronic) resolutions by the Board has not been in use as generally the limited response time precludes success. However, resolutions approved by the Executive

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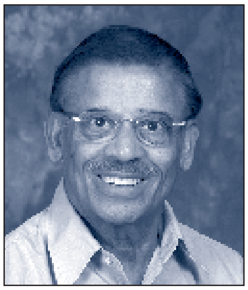
EDITORIAL

by Srinivasa Swaminathan
Dalhousie University, Halifax



Problems and Problem-solving.

Problems worthy of attack prove their worth by hitting back.
- Grook by Piet Hein

During the fall session most university mathematics departments organize classes on "Problem Solving" in order to train undergraduate students to compete in various mathematical competitions in the country and abroad. Typically a set of six or seven problems is given as an assignment to students in a week to be discussed by an instructor during the following week. These problems are not of the type that is familiar to the students from their regular courses. They may be selected from previous competition questions from the William Lowell Putnam competition, the Eötvos (Hungarian) competition, the American Mathematical Monthly Problems section, Crux Mathematicorum, or from other similar problem collections. It is said that the only way to learn mathematics is to try to solve mathematical problems from outside the routine course work. Candidates should be familiar with elementary techniques and results of undergraduate topics so that they understand clearly questions from topics that are usually found in fairly standard texts; these topics may extend to the boundary of what is known.

Competition problems are challenges to thought, avoiding mere technicalities. They are tests of outstanding mathematical ability and as such they do not yield to standard and routine approaches. Contest problems are ever truly original; usually they put together known techniques with, ideally, a little spark of originality to breathe life into the problem. It is sometimes hard to decide whether a question is easy enough. The proposers spend lot of time in framing a question and writing out the official solution which is at most a sample solution and the student is at liberty to find another.

Can the solution be found by an intelligent candidate in the short time available during the examination? Such considerations, including the fact that students are under the stress of examination conditions, are taken into account. Many books are available which provide competition questions and solutions from the examinations of previous years. These make the tasks easy for both instructors and candidates.

Brain teasers, logical puzzles and paradoxes may involve some mathematical idea(s) for their solution without demanding concepts from professional mathematics. Such mathematical recreations are quite popular among creative mathematicians. But creative thought bestowed on solving mathematical games and puzzles can lead to mathematical and scientific discovery; indeed, graph theory may be said to have begun with Euler's analysis of a puzzle concerning crossing bridges, as well as Euler's "officers problem" and Kirkman's "schoolgirls problem" in combinatorics.

Canadians are proud that the first Putnam competition was won by the University of Toronto with Irving Kaplansky as the first Putnam scholar. Canada has done fairly well in subsequent competitions too. At the International Math Olympiad (IMO) in Amsterdam this year the Canadian Team, led by the team leader Dorette Pronk (my colleague) placed 17th (a place shared with the team from the United Kingdom) among 101 countries, and our team of six students returned home with six medals: three bronze, two silver and one gold (in the same proportion in which the medals are awarded at the IMO). This was a very respectable score for a team with four new students. The gold medal went to our youngest team member, Alex Song, who was only 14 years old at the time. He gives us a promising start for building next year's team. That team will compete in Argentina, and their leader will be Jacob Tsimerman, who himself had a perfect score on his IMO in 2004 in Greece.

NOTES DE LA SMC / CMS NOTES

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Note aux auteurs : indiquer la section choisie pour votre article et le faire parvenir au Notes de la SMC à l'adresse postale ou de courriel ci-dessous.

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ÉDITORIAL

par Srinivasa Swaminathan
Dalhousie University, Halifax

Les problèmes et la résolution de problèmes.

Les problèmes dignes d'intérêt pour ceux qui souhaitent s'y attaquer montrent leur trempe en organisant leur propre contre-attaque.
- Grook de Piet Hein

Pendant la séance d'automne, la plupart des départements de mathématiques des universités donnent des cours sur la « résolution de problèmes » afin de former les étudiants de premier cycle et de leur permettre de participer à divers concours de mathématiques au pays et à l'étranger. Habituellement, un ensemble de six ou sept problèmes est confié aux étudiants au cours d'une semaine. La semaine suivante, un instructeur en discute. Ces problèmes ne ressemblent pas à ce que les étudiants voient dans leurs cours ordinaires. Il peut s'agir de questions d'un ancien concours, notamment les concours William Lowell Putnam et Eötvos (hongrois), de questions provenant de la section des American Mathematical Monthly Problems, du Crux Mathematicorum ou d'autres collections de résolution de problèmes analogues. On dit que la seule façon d'apprendre les mathématiques est de s'attaquer à des problèmes de mathématiques qui ne font pas partie du travail ordinaire du cours. Les candidats devraient connaître les techniques élémentaires et les résultats de sujets abordés au premier cycle pour comprendre clairement les questions découlant de sujets qu'on retrouve habituellement dans des textes relativement courants. Ces sujets peuvent aller jusqu'à la limite du connu.

Les problèmes proposés dans le cadre de concours sont des défis pour le raisonnement qui évitent les simples détails techniques. Ce sont des tests d'aptitudes exceptionnelles en mathématiques et, par conséquent, ne se prêtent pas aux démarches normales et habituelles. Les problèmes proposés dans les concours sont rarement des problèmes inédits. Habituellement, ils rassemblent des techniques connues et une touche d'originalité pour se donner un nouveau souffle de vie. On a parfois de la difficulté à décider si une question est suffisamment facile. Les gens qui proposent des problèmes consacrent beaucoup de temps à l'encadrement d'une question et à la préparation de la solution officielle, qui est tout au plus un exemple de solution. L'étudiant est libre d'en trouver une autre.

Un candidat intelligent peut-il trouver la solution dans le court délai qu'on lui accorde au cours de l'examen? De tels facteurs, y compris celui du stress que subissent les étudiants dans des conditions d'examen, sont bien pesés et pris en compte. On retrouve de nombreux ouvrages comptant les questions et les solutions de concours passés. Ces ouvrages facilitent la tâche aux instructeurs et aux candidats.

La solution à des casse-tête stratégiques, des casse-tête logiques et des paradoxes peut être fondée sur des idées mathématiques quelconques sans qu'on y intègre des notions des mathématiques professionnelles. De telles récréations mathématiques sont très populaires chez les mathématiciens dotés d'un esprit créateur. Mais le génie créateur appliqué à la résolution de jeux et de casse-tête mathématiques peut entraîner des découvertes mathématiques et scientifiques; en effet, on peut dire que la théorie des graphes a vu le jour lorsque Euler a analysé un casse-tête ayant pour thème la traversée de ponts; on peut en dire de même pour le « problème des officiers » d'Euler et le « problème des fillettes d'école » de Kirkman en combinatoire.

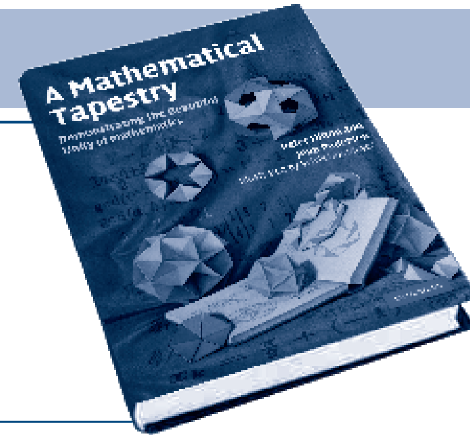
Les Canadiens sont fiers d'apprendre qu'Irving Kaplansky de l'Université de Toronto a remporté la première bourse du concours Putnam. Le Canada s'en est relativement bien tiré aussi dans les concours qui ont suivi. À l'Olympiade internationale de mathématiques (OIM) à Amsterdam cette année, l'équipe canadienne, qui était dirigée par la chargée d'équipe, Dorette Pronk (ma collègue) s'est classée 17e (rang qu'elle partage avec l'équipe du Royaume-Uni) sur 101 pays, et notre équipe de six étudiants est rentrée au pays avec six médailles : trois de bronze, deux d'argent et une médaille d'or (selon la même proportion que celle de l'attribution des médailles à l'OIM). Une note très respectable pour une équipe comptant quatre nouveaux membres. La médaille d'or a été décernée au plus jeune membre de notre équipe, Alex Song, qui n'avait que 14 ans à l'époque. Il nous donne un élan prometteur pour la constitution de l'équipe de l'année prochaine. Cette équipe participera au concours en Argentine. Le chef d'équipe sera Jacob Tsimerman, qui a lui-même eu une note parfaite au concours de l'OIM en 2004, en Grèce.

Letters to the Editors
Lettres aux Rédacteurs

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 notes-letters@cms.math.ca or at the Executive Office.

Les rédacteurs des NOTES acceptent les lettres en français ou anglais portant sur un 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'addresse suivante : notes-lettres@smc.math.ca.

BOOK REVIEW



A Mathematical Tapestry: Demonstrating the Beautiful Unity of Mathematics

By Peter Hilton and Jean Pedersen
Illustrated by Sylvie Donmoyer
Cambridge University Press, 2010.
ISBN 978-0-521-76410-0 Hardback, ISBN 978-0521-12821-6 Paperback
290 pp, 170 illus.

Reviewed by Hans Walser, ETH Zurich and University of Basel

This book is a sort of legacy of the long lasting mathematical and didactical cooperation between Jean Pedersen and Peter Hilton. Peter Hilton died November 6, 2010, at age 87. The book demonstrates how a simple geometric idea reveals fascinating connections and results in number theory, polyhedral geometry, combinatorial geometry, and group theory.

Most of the chapters start with "hands-on geometry", i. e., by folding paper or strips of paper. Very often the beginning is arbitrary, but then, using a folding algorithm, we get surprising constant results. For instance an arbitrary starting angle leads to a limit angle of exactly 60°. Here mathematics comes in: Why is it so? Can we prove it? Can we modify the folding algorithm to get other limit angles? With an angle of 60° we arrive at the geometry of the equilateral triangle. Now we can build for example the famous hexaflexagon, which has the topology of the Moebius band. Or, using several parts of folded strips, we can assemble them into polyhedra containing equilateral triangles as faces, as for example tetrahedra, octahedra, icosahedra and others, especially star polyhedra. Assembling the strips, we get into the symmetry of these polyhedra.

But there is more. It is well known in geometry, both by experience and by a theorem of Gauss, that we do not have a Euclidean construction with ruler and compass for the 7-gon. But there are other ways to get a 7-gon, one of them using a folding algorithm described in this book. The procedure is exact up to a limit. It gives an approximation, but the more you work, the closer you come to the exact 7-gon.

It is quite difficult to describe a folding algorithm and the spatial assembling of the different parts in a written text or even in a spoken language. Therefore the book contains a lot of instructive step by step illustrations. But nevertheless the chapters of the book are not meant to be read and looked at, but really to be done. The reader is kindly invited to begin with his/her own hands using some simple examples. With some initial experience and routine, one can easily cope with more interesting and sophisticated examples.

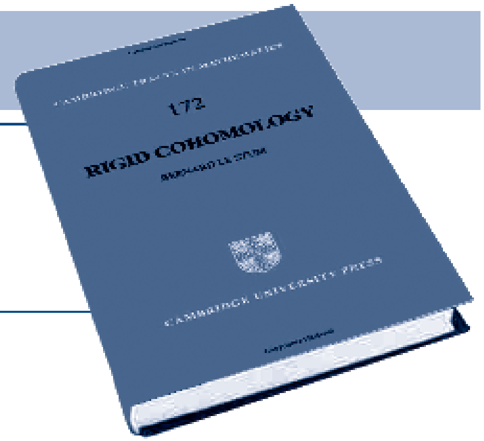
I have used ideas from this book for teaching students both of middle school and university level, and also in teacher training. The students were always highly fascinated and soon made their own models, varying the examples of the book. And they told their friends and families about their work, giving rise to a sort of epidemic mania. This is good for mathematics.

Children are much faster in understanding and working about the ideas of this book than adults who are experienced in hands-on geometry. Thus if you need an hour to build up an example, your children will do the same in less than an hour.

The book has also to do with art and aesthetics. Though the illustrations inside the book are only in black and white, the reader is advised to use colored paper. In my classroom I always carry a collection of paper colored strips of the same size, so that students can collaborate and work with these colored strips. Choosing their favorite color is important to children. The cover of the book shows a fascinating collection of colored models.

The book is dedicated to the memory of Martin Gardner (1914-2010). It contains   historical remarks about mathematics, mathematicians, their ideas and results.

BOOK REVIEW



Rigid Cohomology

by Bernard Le Stum.
Cambridge Tracts in Mathematics
ISBN : 9780521875240

Reviewed by Bruno Chiarellotto, Univ. of Padova (Italy).

Il est classique que pour une variété différentielle X sur le corps des réels $\mathbb{R}$, quelques invariants topologiques très importants (par example les nombres de Betti, qui sont définis via la cohomologie/homologie singulière) peuvent être obtenus en utilisant la structure différentielle de X, notamment avec la théorie de de Rham : les formes différentielles fermées qui ne sont pas exactes sont liées à la topologie de la variété différentielle. Si X admet en outre une structure complexe (en particulier une structure de Kähler), des invariants plus sophistiqués et des liens entre invariants topologiques peuvent être trouvés grâce à la théorie de Hodge (toujours dans le cadre différentiel). Si on veut travailler avec des variétés sur un corps quelconque k, on voudrait aussi retrouver des invariants similaires. Quand on parle de « corps quelconque », on peut penser à un corps de caractéristique finie ou à un corps de caractéristique nulle mais sans topologie : nos variétés seront donc algébriques. Le sujet du livre *Rigid Cohomology* est de donner pour la première fois une introduction systématique à la méthode qui, ces vingt dernières années, a fourni le plus de résultats sur le sujet dans le cas d'un corps k de caractéristique finie. On peut pas terminer cette introduction sans mentioner le résultat de Grothendieck (*On the de Rham Cohomology of algebraic varieties* Publ.Math. de IHES n.29, 1966, 95-103) qui dit que pour une variété algébrique complexe (non propre) X sur le corps des complexes, les invariants topologiques de la variété analytique associée peuvent être retrouvés en utilisant seulement des méthodes algébriques (*i.e.* le complexe de de Rham algébrique).

Le problème considéré dans le livre en question est donc de donner une méthode cohomologique fournissant des invariants pour une variété algébrique définie sur un corps k de caractéristique finie. Il est clair qu'une approche du style cohomologie singulière ne peut pas être utilisée : la notion de chemin est difficile à traduire dans ce contexte. Il reste la théorie de de Rham ou son intérpretation en termes de cohomologie des faisceaux. Mais il est aussi évident que si on reste en caractéristique finie (disons p), d'autres problèmes vont apparaître. Par example, les dérivations tuent non seulement les constantes, mais aussi les polynômes du type x^{p^k} avec $k \in \mathbb{N}$. Il est donc évident qu'on doit « passer à la caractéristique nulle », c'est-à-dire trouver un relèvement en caractéristique 0 de la variété considérée, et donc de voir le corps de base k (de caractéristique p) comme le corps résiduel d'un anneau de valuation discrète complet $\mathcal{V}$ (par exemple, $\mathcal{V} = \mathbb{Z}_p$ lorsque $k = \mathbb{F}_p$). Notons π une uniformisante de $\mathcal{V}$ et $X_{\mathcal{V}}$ un relèvement de X sur $\mathcal{V}$. Des problèmes subsistent : p n'est pas inversible dans $\mathcal{V}$ et donc les polynômes du type x^{p^n-1} ne peuvent pas être intégrés ! On peut alors considérer la fibre générique X_K de $X_{\mathcal{V}}$ sur K (où K est le corps des fractions de $\mathcal{V}$). Il semble que nos problèmes soient terminés, mais on doit aussi prendre en compte le fait que le relèvement n'est pas unique. En effet, aussi bien $\operatorname{Spec} \mathcal{V}[x, y]/(xy - 1)$ que $\operatorname{Spec} \mathcal{V}[x, y, z]/(xy - 1, z(p + x) - 1)$ donnent un relèvement de $\operatorname{Spec} k[x, y]/(xy - 1)$, mais leurs fibres génériques sont différentes : dans le premier cas, c'est la droite affine sur K moins un point (l'origine) tandis que dans le deuxième cas, c'est la droite affine moins deux points. Le fait que la théorie cohomologique soit indépendente du relèvement a été la base de la théorie introduite par Grothendieck puis développée par Berthelot et Ogus, appellée *cohomologie cristalline*. L'idée est de prendre tous les relèvements possibles (définis sur $\mathcal{V}/(\pi^n)$ pour $n \in \mathbb{N}$ fixé ou de nature locale) et de construire ainsi un site (le *site cristallin*) qui admet un faisceau structural, et dont la cohomologie est la cohomologie envisagée. Les groupes de cohomologie $\mathrm{H}_{\mathrm{cris}}(X, \mathcal{V}/(\pi^n))$ ainsi définis sont des modules sur $\mathcal{V}/(\pi^n)$. La cohomologie cristalline a été largement étudiée dans les années 70 et 80 (Berthelot, *Cohomologie cristalline des schemas en car.* $p > 0$ LNM 407, Springer 1974. P. Berthelot, A. Ogus *Notes* *on crystalline cohomology*, Princeton Univ. Press 1978.). Bien qu'ayant des propriétés remarquables (par example, si la variété X est la réduction d'une variété propre et lisse sur $\mathcal{V}$, alors la limite $\mathrm{H}_{\mathrm{cris}}(X, \mathcal{V})$ des $\mathrm{H}_{\mathrm{cris}}(X, \mathcal{V}/(\pi^n))$ par rapport à n, tensorisée par K sur $\mathcal{V}$, est isomorphe à la cohomologie de de Rham de sa fibre génerique), cette théorie n'est pas bonne dans le cas de variétés ouvertes ou non propres. C'est encore Berthelot qui, au début des années 80, a commencé à élaborer une nouvelle théorie qui devait correspondre à la cohomologie cristalline dans le cas propre et lisse (toujours pour une variété en caractéristique finie), mais donner aussi de bons résultats (de finitude, par example) dans le cas ouvert ou non lisse. Elle a été appelée *cohomologie rigide* : elle se calcule en utilisant l'hypercohomologie d'un complexe de de Rham défini sur un relèvement d'une compactification de la variété, avec des coefficients « surconvergents » ou « dag » (notés avec †). Berthelot, dans ses articles fondateurs a aussi introduit des cofficients qui devaient être les analogues dans ce monde des modules à connection (*i.e.* des équations différentielles) : les *(iso)cristaux surconvergents*. Pendant des années, la théorie a été utilisée et des calculs sur de nombreux exemples ont étayé le fait qu'il s'agissait de la bonne cohomologie. La théorie était étudiée, mais pas de façon systématique : pendant longtemps, la seule source a été une prépublication écrite par Berthelot (mais jamais publiée). Par ailleurs, le fait que la finitude de cette cohomologie n'était pas démontrée en général poussait les chercheurs à traiter le sujet avec circonspection. Il semblait que la finitude était liée à la résolution des singularitées en caractéristique p. La théorie a été dopée par le résultat de de Jong sur les altérations (une version édulcorée de la résolution des singularités), grâce auquel Berthelot a démontré la finitude et tout le formalisme d'une bonne cohomologie avec les axiomes de Bloch-Ogus (Inv. Math. 129(1997), 329-377). Étant fonctoriels, les groupes de cohomologie associés admettent un Frobenius, et donc une structure d'*isocristal*. Leur décomposition suivant les poids est l'analogue en caractéristique p de la théorie de Hodge classique : elle doit fournir la réalisation cristalline du motif associé. Une introduction systématique à la théorie manquait : le livre de Le Stum couvre ce manque pour une théorie qui est à la base de l'étude de la structure des variétés en caractéristique p ou définies sur un DVR de caractéristique mixte. En effet, le livre traite des bases de la théorie avec la notion de tubes et l'indépendence de sa définition par rapport aux choix. Dans ce cadre, les coefficients rigides (*i.e.* les isocristaux surconvergents) sont introduits. On peut donc voir ce livre comme la première introduction systématique à la théorie de la cohomologie rigide. C'est un point de départ pour pouvoir comprendre les développements récents de cette théorie : les $\mathcal{D}$-modules arithmétiques et la structure des poids. Le livre est très lisible et même « agile » en considérant l'étendue de la théorie. Étant une bonne cohomologie de Weil (et donnant donc la fonction Zéta des variétés) la cohomologie rigide a récemment été utilisée numériquement pour le comptage des points de variéés en caractéristique p et pour la cryptographie. C'est d'ailleurs par la cryptographie que le livre est introduit.

WANTED: Books for Review
RECHERCHÉS : Livres pour critiques littéraires

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Would you like to see it reviewed in the CMS Notes? If so, please arrange to have a review copy sent to our Book Review Editor.

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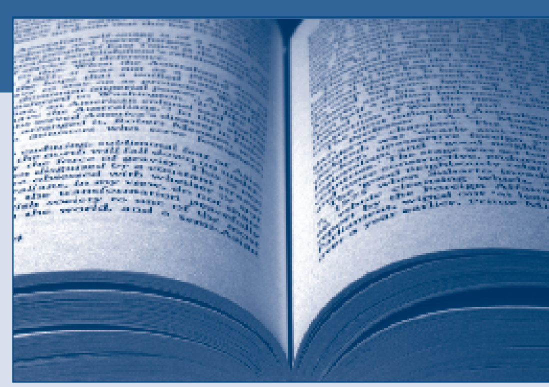
Vous aimeriez une critiques littéraires de celui-ci dans les Notes de la SMC? Si oui, veuillez faire parvenir une copie au rédacteur des critiques littéraires.



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2012 CMS MEMBERSHIP RENEWALS
RENOUVELLEMENTS 2012 À LA SMC

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✧ ✧ ✧

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BRIEF BOOK REVIEWS

by Srinivasa Swaminathan
Dalhousie University, Halifax

Holomorphic Dynamics and Renormalization A Volume in Honour of John Milnor's 75th Birthday

Edited by Mikhail Lyubich & Michael Yampolsky
Fields Institute Communications v. 53
ISBN 978-0-8218-4275-1
viii + 395pp. American Math. Society 2008

The papers collected in this volume reflect some of the directions of research in two closely related fields: Complex Dynamics and Renormalization in Dynamical Systems.

While dynamics of polynomial mappings, particularly quadratics, has by now reached a mature state of development, much less is known about non-polynomial rational maps. The reader is introduced into this fascinating world and a related area of transcendental dynamics by the papers in this volume.

A survey by V. Nekrashevych introduces the reader to iterated monodromy groups of rational mappings, a recently developed subject that links geometric group theory to combinatorics of rational maps. In this new language, many questions related to Thurston's theory of branched coverings of the sphere can be answered explicitly.

Renormalization theory occupies a central place in modern Complex Dynamics. The progress in understanding the structure of the Mandelbrot set, polynomial Julia sets, and Feigenbaum-type universalities stems from renormalization techniques. Renormalization of circle maps and rotation domains, such as Siegel disks, can be understood in the context of the classical KAM theory. Corresponding phenomena in higher dimensions, such as universal scaling in area-preserving maps in 2D, on the boundary of KAM, pose a challenging problem. A survey by H. Koch on Renormalization and several other papers in this area provide a good introduction to this area of study.

There are open problems and beautiful computer simulations which will be useful to graduate students.

Lectures on Global Optimization

Edited by Panos M. Pardalos & Thomas F. Coleman
Fields Institute Communications v. 55
ISBN 978-0-8218-4485-4
vii + 243pp. American Math. Society 2009

A large number of mathematical models in many diverse areas of science and engineering have lead to the formulation of optimization problems where the best solution (globally optimal) is usually sought. Due to the interdisciplinary nature of global optimization, there has been good progress in this field during the last few decades. Many powerful computational algorithms and new theoretical developments have been introduced to solve a spectrum of hard problems in several disciplines.

This book covers a small subset of recent important topics in global optimization with emphasis on recent theoretical developments and scientific applications. The chapters are based on the talks presented at the workshop on "Global Optimization: Methods and Applications" that was held at the Fields Institute from May 11-12, 2007. The volume will be useful to graduate students in mathematics,engineering, and sciences, academic researchers, as well as practitioners, who use global optimization for their specific needs and applications

New Perspectives in Mathematical Biology

Edited by Siv Sivaloganathan
Fields Institute Communications v. 57
ISBN 978-0-8218-4845-6
x + 219pp. American Math. Society 2010

In the 21st century, the interdisciplinary field of mathematical biology and medicine has firmly taken center stage as one of the major themes of modern applied mathematics, with strong links to the empirical biomedical sciences. This book provides an overview of the distinct variety and diversity of current research in the field. The papers in this volume cover themes ranging from cancer modeling to infectious diseases to orthopaedics and musculoskeletal tissue mechanics. There is evidence of the strong connections and interactions of mathematics with the biological and biomedical sciences that have spawned new models and novel insights.

This book is loosely based on the plenary lectures delivered by some of the leading authorities on these subjects at the Society for Mathematical Biology (SMB) Conference that was held in Toronto in 2008 and will be of interest to graduate students, postdoctoral fellows, and researchers currently engaged in this field, bringing the reader to the forefront of current research.

Geometric Representation Theory and Extended Affine Lie Algebras

Edited by Erhard Neher, Alistair Savage and Weiqiang Wang
Fields Institute Communications v. 59
ISBN 978-0-8218-5237-8
vii + 213pp. American Math. Society 2011

The theory of Lie algebras has connections to many other disciplines such as geometry, number theory, mathematical physics, and algebraic combinatorics. The interaction between algebra, geometry and combinatorics has proved to be extremely powerful in shedding new light on each of these areas.

This book presents the lectures given at the Fields Institute Summer School on Geometric Representation Theory and Extended Affine Lie Algebras held at the University of Ottawa in 2009. It provides a systematic account by experts of some of the exciting developments in Lie algebras and representation theory in the last two decades. It includes topics such as geometric realizations of irreducible representations in three different approaches, combinatorics and geometry of canonical and crystal bases, finite W-algebras arising as the quantization of the transversal slice to a nilpotent orbit, structure theory of extended affine Lie algebras, and representation theory of affine Lie algebras at level zero.

This book will be of interest to mathematicians working in Lie algebras and to graduate students interested in learning the basic ideas of some very active research directions. The extensive references in the book will be helpful to guide non-experts to the original sources.

Education **NOTES**

By John Grant McLoughlin *and* **Jennifer Hyndman**
University of New Brunswick *University of Northern British Columbia*

This edition of the *Education Notes* features two pieces focusing respectively on opportunities for encouragement of Aboriginal youth and of female undergraduates. The first is an article that draws attention to a set of books and videos that encourage discussion of mathematical ideas. The work has been created and translated into two First Nation languages with the goal of encouraging Aboriginal youth to succeed in mathematics at the primary and secondary level. While the success rate for girls completing high school and undergraduate-level mathematics is better than that of Aboriginal students, women do not go on to research careers at the same rate that men do. The second piece announces a summer school initiative for undergraduate women to be held in August 2012 at the University of Waterloo, in an effort to encourage the participants to pursue graduate studies.

Small Number: Breaking the Pattern

Veselin Jungic, Department of Mathematics, Simon Fraser University
Mark MacLean, Department of Mathematics, University of British Columbia

In Spring 2011, NSERC awarded a PromoScience grant to the project *Math Catcher: Mathematics Through Aboriginal Storytelling*, which was proposed by the first author of this note. The project is also sponsored by the Pacific Institute for Mathematical Sciences, the Faculty of Science, the Department of Mathematics and the IRMACS Centre from Simon Fraser University, and the Department of Mathematics from the University of British Columbia.

The project is an outcome of the BIRS supported First Nations Math Education Workshop which was held in Banff, Alberta, in November 2009[1]. As it is stated in the Workshop's Final Report [R]:

> [t]he workshop was based on the assumption that First Nations/Aboriginal student participation and success in school math programs is limited. (...) Presently only 2% of BC's Aboriginal population completes Principles of Mathematics 12 compared to a completion rate of 25% for the whole BC population. This discrepancy in completion rate is one of the issues this group wanted to address given that successful completion of Principles of Mathematics 12 is a compulsory entrance prerequisite for many post secondary programs in British Columbia, and the statistics are similar in the other provinces.

The project was particularly inspired by the following two conclusions identified by Workshop participants as strategies for overcoming challenges in teaching mathematics to Aboriginal youth [R]:

- Teach math in the cultural context of the students,
- Teach basic skills and problem-solving early.

During the workshop, the authors of this note co-wrote a story, *Small Number Counts to 100*, which served as the cornerstone of the grant proposal.

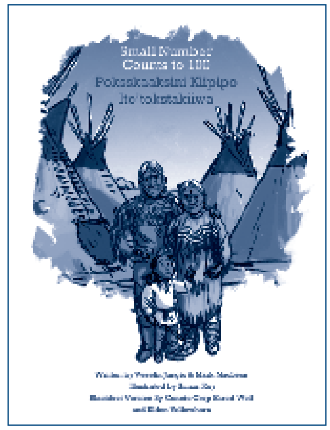

Figure 1 The cover page of the bilingual Blackfoot—English picture book

The *Math Catcher: Mathematics Through Aboriginal Storytelling* project includes the creation of a series of short animated films that accompany picture books, as well as the development of related activities that introduce math topics and techniques through stories that follow Aboriginal storytelling formats and contain elements of Aboriginal traditions and cultures. The animations and books have English, French, and Aboriginal languages versions. The primary objective of the program is to promote mathematics among elementary and high school students, as well as members of the Aboriginal communities, both in urban settings and on reserves. This is to be done in a way that Aboriginal children see themselves and their culture connected with mathematics. There are two further and, in our view, equally important objectives. First, short films in Aboriginal languages play a double role by promoting both mathematics and the languages. Second, through the movies, the picture books, and the activities that are built around these resources, we use mathematics as a vehicle to promote Aboriginal traditions and cultures among non-Aboriginal young people.

The main purpose of the short films, which are 3-4 minutes in length, is to relate stories about the adventures of animated characters. The scenarios take place in Aboriginal cultural and physical environments. The resolution of a particular plot always requires some mathematical knowledge. Plots in our stories are a mixture of adventures and math puzzles with the aim of catching

[1] The next First Nations Math Education Workshop is scheduled for November 18-23, 2012. For details see www.birs.ca/events/2012/5-day-workshops/12w5076.

a viewer's attention and interest (thus the title of our project). Each story closes with an open-ended question that should spark discussions and lead to further activities. The question at the end of each story is purposefully not answered in the story.

As much as possible, hands-on activities are used to introduce fundamental mathematical ideas and techniques. Participants are asked to measure, construct, draw, colour, calculate, recognize, describe, tell or make up a story, and so on. Another level of interaction is between our volunteer presenters and participants. The authors of this note firmly believe that a positive role model, i.e., somebody who demonstrates their confidence, knowledge, love and passion for mathematics in a friendly environment, can play a crucial role influencing a young person's life-long attitude towards mathematics. For example, by bringing bright and enthusiastic math students and faculty to a school, onto a reserve, or into an Aboriginal urban community center, and by giving them a chance to talk to and work with young program participants in a friendly and familiar physical and cultural space, we help the participants recognize and understand that mathematics is something interesting and within their reach.

The main character in our animations thus far is a boy called *Small Number*. He is a bright, playful kid, with the ability to recognize patterns and calculate quickly. The name of our hero was inspired by two theorems and the experiences that the first author had as a math instructor in the Aboriginal University Prep Program and the Aboriginal Pre-Health Program at SFU, and as a volunteer math tutor at the Vancouver Aboriginal Friendship Centre. As a volunteer, he had a chance to work with a group of very young Aboriginal students all between the first and seventh grades of elementary school. Most of them were just that, very young urban kids more interested in playing computer games than in doing mathematics, but some of them[2] expressed real enjoyment in solving math puzzles, playing math games, finding various patterns and completing pages and pages in their math workbooks.

Working with adult students in the two SFU Aboriginal programs, the first author often found himself puzzled at the gap between students' talent for mathematics and their[3] level of formal math education.

The result of these experiences—an impression that early math potential is not matched with the right outcome—might be described by the Law of Small Numbers as it was stated in [GRS]: *Patterns discovered for small k disappear for k sufficiently large to make calculations difficult*.[4] The authors are aware (and afraid) that the present situation in Aboriginal math education combined with other factors, would probably be better described by the Strong Law of Small Numbers [G], *There aren't enough small numbers to meet the many demands made of them*.[5]

Other characters introduced so far[6] are Big Circle, Small Number's best friend, Perfect Number, Small Number's sister, and Small Number's mother and grandparents. An important part of our stories is love. His grandparents, his mother, his sister, and his friend all love Small Number, and he loves them back.

To underline the universality of mathematics, Small Number and the plots of our stories are not attached to a particular time and space. In the first story Small Number lives in a tipi settlement somewhere in the plains. In the second story he lives by a body of water, a river or a sea, and the third story is set in an urban environment.

Our intention is to create stories in such a way that they allow for interpretations at multiple levels of mathematical knowledge. For example, our first story, *Small Number Counts to 100* [SN1B], [SN1C], [SN1E], can be shown to elementary school students as a counting practice/ puzzle or as a pattern recognition problem. For high school students it could be a way to introduce arithmetic progressions, modular addition, or an idea of number systems with a base different than 10.

In *Small Number and the Old Canoe* [SN2E] mathematics is present throughout the story with the hope that this experience will make at least some members of our young audience, with the moderator's help, recognize more mathematics around them in their everyday lives. We use terms like *smooth, shape, oval*, and *surface,*

[2] A little girl who with children's kindness and a mature graciousness was letting her opponent, a man with a white beard, win the game they were playing; a pair of brothers finding patterns in the game of *Set* with lightening speed; or a tall quiet boy who was solving problems from math competitions above his grade level, are just a few examples.

[3] A recent high school graduate who demonstrated in class an absolute understanding and knowledge of Math 11 just shrugged her shoulders when asked why she didn't take Math 12; a women in her mid-thirties, back in a math class after working in construction for good part of her life showed such talent for mathematics that, even a few years later, her instructor cannot stop thinking where she would be if she started studying mathematics in her teenage years; or a man in his early forties with one of the finest analytical minds that his instructor, a working mathematician for the last 33 years, has ever witnessed, are some examples.

[4] We read "small" as "young".

[5] Richard Guy, who stated the Strong Law of Small Numbers, was one of the participants of First Nations Math Education Workshop in 2009.

[6] Three stories have been created at the time of writing this note.

the mathematical phraseology like, *It must be at least a hundred years old*, our artist[7] skillfully presents reflection (symmetry) of trees in water, and so on. The idea behind this approach is to give the moderator a few openings to introduce or emphasize various mathematical objects, concepts, and terminology. The short film is a little math suspense story and our question is related only to the last part of it. The aim of the question is to lead to an introduction at an intuitive level of the concept of a function and the essence of the principle of inclusion-exclusion as a counting technique. We would also like to give our audience an opportunity to appreciate that in order to understand a math question, one often needs to read (or in this case, watch) a problem more than once.

The mathematical context of the third story, *Small Number and the Basketball Tournament*, contains some basic principles of combinatorics. The plot of the story and the closing question are structured in a manner that allows the moderator to introduce the notion of permutations and combinations. Since the numbers used in the story are relatively small, this can be used to encourage the young audience to explore on their own. Mathematics is also present in the background. Small Number and his friends *do mathematics* after school in the *Aboriginal Friendship Centre*. He loves playing the game of *Set* and when he comes home his sister is *just finishing her math homework*. Small Number and his friend would like to participate in a *big half-court tournament*, and so on.

Even though our project is still at its beginning, it has already significantly contributed to our lives and to the lives of others[8]. We had the privilege to meet and discuss our project with a number of representatives from various Aboriginal communities in British Columbia and Alberta. Our visits to a number of communities went very well. In addition, the response to our search for volunteers has exceeded our expectations and we believe that in our group of volunteers we will have a few Aboriginals. Most importantly, we have learned so much about Aboriginal cultures and we are even more aware about the importance of encouraging young members of the Aboriginal population in Canada to study mathematics.

Next we list some of the challenges that we have been facing:

Mathematics

What are the appropriate mathematical topics that should be presented to student participants in the project? How can we use the full potential of the medium (story, images, sound) to transmit the intended math information? Should we make any assumptions about participants' previous math knowledge in our sessions? What additional material should accompany our stories so that they can be used as resources in classrooms?

Language

Finding people willing to read stories in their native languages has proved difficult. In addition, we have been gently warned that different communities inside the same nation could be very sensitive regarding the specifics of their own dialects. We were asked to make choices that we were not qualified to make, like choosing between writing the Cree translation of the first story in orthography or syllabics [SN1C]. We have learned how precious native languages are for Aboriginal people and what a crucial role elders play in preserving languages and passing them on to new generations.

Culture

The co-authors[9] of the *Small Number* stories are two mathematicians who are interested in promoting mathematics and who have enormous respect for Aboriginal culture traditions. As mathematicians, we have tried to be extremely careful with everything related to Aboriginal cultures. In their essence, our stories are inspired by what we have read in relevant literature, by what we heard from our Aboriginal friends, and by what we experienced working with the Aboriginal students. We share our stories and images during their inception with our Aboriginal colleagues to receive their opinions and suggestions. Perhaps the biggest compliment that we have received so far was the comment that our stories are *culturally sensitive*[10]. Still, the cultural component is the most delicate part of our project. Our approach has been to avoid specifics as much as possible, but still we have not been able to avoid controversy. We have learned that the Aboriginal community is not unanimous on some issues. For example, we witnessed[11] an exchange of completely opposite views between two members of the same First Nation about images in the animated short *Small*

[7] Mr. Simon Roy from Victoria, British Columbia.

[8] For example, the first author invited one of his former Aboriginal students to work on a segment of the project. The young lady, a second generation urban Aboriginal, while searching for a translator for our second story, discovered and got in touch with relatives that she did not know about.

[9] That is, the authors of this note.

[10] In a letter from the First Nation Adult and Higher Education Consortium, Calgary, AB.

[11] On June 7, 2011, in one of many Starbucks outlets in the Greater Vancouver Area.

Number Counts to 100. For one of our friends, the images were inappropriate because they *supported a colonial view of Aboriginal history*. The other friend said that he *liked them* because they represented exactly what, he said, *we are*. Sometimes our ignorance causes the controversy. For example, we have been reminded that totem poles that appear in our second animation are not universal on the coast of BC. In many cases, like the Musqueam, lodge poles were carved only for longhouses.

Reaching to Schools and Communities
We have established contacts with several school districts in the Lower Mainland as well as with a number of schools on reserves. There is no doubt that there is good will to support the program on all sides. It seems that expectations vary from institutions to institution. For example, one school district is expecting us to meet with a group of teachers and to help them to develop lesson plans around our stories. Another sees our visits as an opportunity to have a joint event for Aboriginal and non-Aboriginal students. We will need time to adjust the program so that we can meet this spectrum of expectations.

Evaluation of the Project
We divide our goals in two parts. One aim is to generally popularize mathematics and to increase students' awareness about the presence and importance of mathematics in their lives. The other is to encourage one bright student in our audience to decide to follow her or his talent and go with mathematics all the way... Is this too much to ask for? Or too little? And how will we know if we meet our hopes and make any changes? Maybe a hint of the answer to our dilemmas is in this philosophical and infinitesimal calculus spirited saying by Crowfoot[12], a chief of the Siksika First Nation,

> What is life? It is a flash of a firefly in the night. It is a breath of a buffalo in the winter time. It is as the little shadow that runs across the grass and loses itself in the sunset.

Acknowledgments: The authors would like to thank Melania Alvarez for inspiring us to develop the program and to Ozren Jungic for his helpful comments and suggestions on various drafts of this note.

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[SN1C] http://vimeo.com/27301049

[SN1E] www.youtube.com/watch?v=gi0-2-vfh58

[SN2E] http://vimeo.com/28020225

Two weeks at WATERLOO - A Summer School for Women in Math

August 12-25, 2012

Kathryn Hare, University of Waterloo

This summer school is an opportunity for up to sixteen outstanding female undergraduate students, from across Canada, to gather together to study topics in mathematics in an intense two-week immersion. The aim is to encourage and inspire these gifted women to continue on to graduate work in mathematics. The program will provide both enrichment of the undergraduate curriculum and a research component, in a collaborative environment.

The students will participate in two mini courses, taught by Prof. Matilde Lalin (University of Montreal) and Prof. Gail Wolkowicz (McMaster University). Four female guest speakers will talk about their work in mathematically-related fields and visits will be made to businesses and institutions which employ mathematicians.

The women will be housed at the University of Waterloo. The students' accommodation, meals and travel costs within Canada will be covered, subject to availability of funds.

The summer school is open to female undergraduate students studying mathematics or a related discipline at a Canadian university, with at least one year of studies remaining in their program. Canadians and permanent residents of Canada studying outside Canada are also eligible to apply.

Applications for this very selective program are due January 31, 2012. For more information and an on-line application form, please go to the website http://women.math.uwaterloo.ca/Summer_School.shtml .

For further information please contact the organizers at wimsummer@math.uwaterloo.ca .

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[12] c. 1821-1830 – April 25, 1890.

Algebraic and Analytic Properties of Network Reliability

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Computer networks require a certain amount of robustness or resilience. Perhaps one is concerned with sabotage, but, more likely, one is worried about random failures of components. The most common model consists of a network that is a (finite) undirected graph for which the vertices are always operational, but each edge is independently operational with probability $p \in [0,1]$. The *all-terminal reliability* is the probability that all the vertices can communicate with one another, i.e. the network contains at least a spanning tree. For example, for a cycle C_n on n vertices, the all-terminal reliability is $p^n + n(1-p)p^{n-1}$, as the network is reliable if and only if at most one edge has failed. All-terminal reliability has been studied since the mid 1950's, and, although it is straightforward to show that the function is a polynomial, it is still in general intractable to compute.

The all-terminal reliability is not the only reliability measure of interest. In networks, for example, links may be unidirectional, rather than bidirectional, and still it may be important to know, in a directed graph, the probability that all pairs of vertices are able to communicate, in both directions, under a similar model of independent arc failures. Such a function is called *strongly connected reliability*, and has, until the last decade, received little attention, not because it is less important, but because it is difficult to work with these functions. Strongly connected reliability has also arisen in the study of the probability that a matrix is irreducible.

While much of the work on network reliability has centred on finding efficient bounds for all-terminal reliability, I have also been drawn to analytical and algebraic properties of the reliability function. For connected graphs, these functions are strictly increasing on $[0,1]$. It was conjectured that reliability functions have at most one point of inflection in $(0,1)$. Perhaps, somewhat surprisingly, it was just shown, [1], [5], that there are infinitely many graphs which have more than one point of inflection, with the smallest being on six points. But even if you are only interested in bounding reliability polynomials, the nature and location of the roots can play a role. For example, if the roots of a polynomial $\sum a_i x^i$ with positive coefficients lie in the sector $\{z \in \mathbb{C} : \frac{2\pi}{3} < \arg z < \frac{4\pi}{3}\}$, then the sequence $\langle a_i \rangle$ is *unimodal*, i.e. hill-shaped: first non-decreasing, then non-increasing. In general, we can only determine quickly some of the coefficients of the polynomial, so the more information we have about the shape of the sequence, the better.

A conjecture that I stated together with Charlie Colbourn, that all the roots of all-terminal reliability polynomials lie in the unit disk $|z-1| = 1$, attracted a fair bit of attention over the decade it was around. Gordon Royle and Alan Sokal found a counterexample, but only by the slimmest of margins: the largest distance known of a root from $z = 1$ is about 1.04. So it seems that a somewhat larger disc, centred at $z = 1$, might still contain the roots.

The problem of the distribution of the roots of strongly connected reliability polynomials, [2], [3], shows how different the situation may be from all-terminal reliability (the roots of strongly connected reliability polynomials of some small directed graphs are shown in Figure 1). It was proved that the closure of the roots of strongly connected reliability polynomials is, in fact, the whole complex plane. The argument, [3], for outside the disk $|z-1| = 1$ involved connections, for one family of directed graphs, to the roots of the difference of two consecutive Chebyshev polynomials of the second kind (all the roots turn out to be real). In [2], for another family of strongly connected directed graphs, we used the Beraha-Kahane-Weiss (BKW) theorem on the limits of roots of recursive families of polynomials $f_n(x)$ that satisfy a homogeneous linear recurrence. Such polynomials can be written in the form $\sum_{l=1}^{k} \sum_{j=1}^{m_l} n^{j-1} \alpha_{l,j} \lambda_l^{n-j}$, where the α's and the λ's are algebraic functions in x. The beautiful and useful

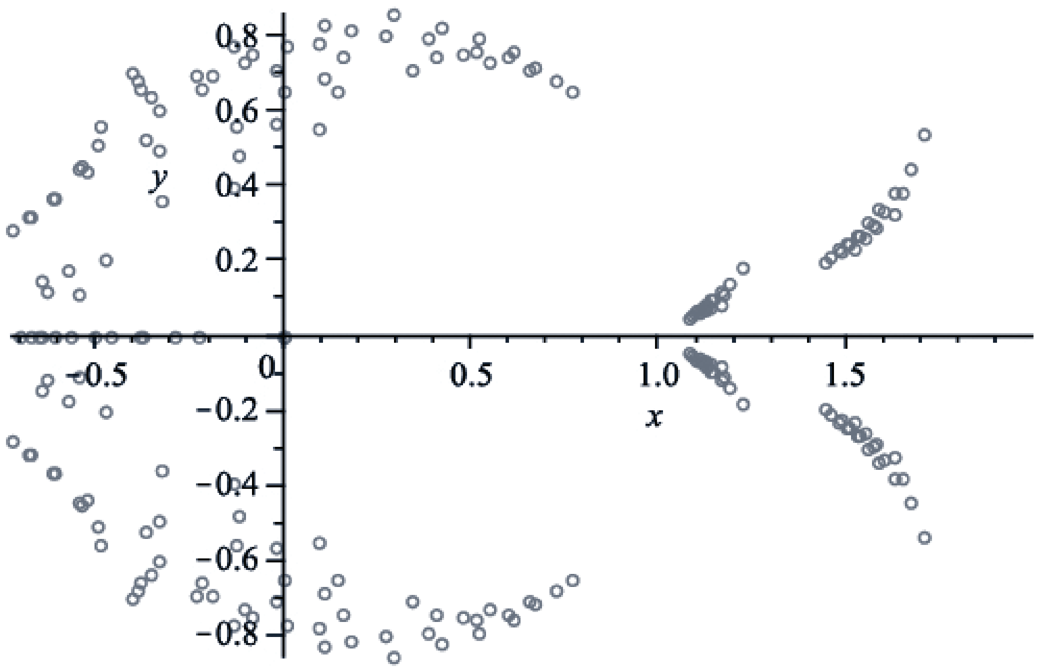

Figure 1: The roots of the strongly connected reliability of some small directed graphs.

BKW Theorem states that, under certain non-degeneracy conditions, the limits of the roots are precisely those points z such that either

(i) two or more of the $\lambda_i(z)$ are of equal modulus, and strictly greater (in modulus) than the others; or

(ii) for some j, $\lambda_j(z)$ has modulus strictly greater than all the other $\lambda_i(z)$ have, and $\alpha_j(z) = 0$.

A broad generalization of reliability has been developed recently. One can view all-terminal reliability as the expectation of a random variable on the spanning subgraphs of a graph that takes value 1 if the subgraph is connected, and 0 otherwise. In some recent work, [4], we considered the random variable that takes on a polynomial value on each subgraph H, namely the *independence polynomial* $i_H(x)$ (the generating function whose k-th coefficient is the number of independent sets in the subgraph). The associated expectation is called the *expected independence polynomial*, and is a polynomial in two variables. We see that for any fixed probability $p \in (0, 1)$ the polynomial has all roots real. But we also develop an asymptotic formula for the value of this function at $x = 1$, and thereby find upper and lower bounds for the average number of independent sets of a graph that both look like

$$\frac{C(p)}{\sqrt{w(n)}}\exp\left(-\frac{w(n)^2+2w(n)}{2\log(1/2)}\right)$$

for different values of the constant $C(p)$, where $w(n) := W(n\sqrt{y}\log y)$ and W denotes the *Lambert* W *function*, one of my favourites, which is the inverse of $We^W = x$. But the entire area of reliability revolves around interesting functions, polynomial and non-polynomial alike, and often takes us to new problems and to applications of old research. What could be better than that?

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Singularities of Analytic Dynamical Systems

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The theory of dynamical systems studies time-dependent systems. The simplest are the ordinary differential equations (ODEs): $\dot{X} = v(X)$, where $v\colon U \to \mathbb{R}^n$ is a vector field on an open set U of $\mathbb{R}^n$, called the phase space, and the difference equations: $X_{n+1} = F(X_n)$, when time is discrete. We focus on analytic ODEs that satisfy existence and uniqueness of local solutions for initial value problems. *Given an initial condition, what is the long-time behaviour of a solution?* This fundamental question is very hard: ad-hoc techniques are found for simple special cases, but there are no general methods, though some unifying principles exist:

(i) Instead of studying one particular solution, try to understand the solution set, which yields a partition of the phase space into trajectories, called phase portrait, studied with the help of geometric methods—ideas due to Poincaré.

(ii) The singularities organize the phase portrait.

(iii) Dynamical systems often depend on parameters. Some special values of the parameters, called bifurcations, correspond to qualitative (topological) changes in the phase portrait. We try to partition the parameter space into regions where the systems have similar qualitative behaviour. This partition is called the *bifurcation diagram*. The unifying principle is that the most degenerate (highest co-dimension) bifurcations organize the bifurcation diagram—idea due to Arnold.

Principles (ii) and (iii) are very useful, since they allow the use of local techniques, in particular power series expansions, both in phase space and in parameter space. They explain why the study of singularities of dynamical systems is so important.

In analytic dynamics, a fundamental question, celled the equivalence problem, is: *Given two systems with a singularity, can we find a local analytic change of coordinates defined in the neighbourhood of the singularities (adding, perhaps, an analytic time scaling) that brings one system to the other?* Since natural dynamical systems often depend on parameters, the equivalence problem for families of dynamical systems is also a fundamental question. A simple way to answer the equivalence problem would be to bring the system to a simple normal form: the idea is similar to that of the Jordan normal form for matrices. This is indeed possible formally (i.e. by means of

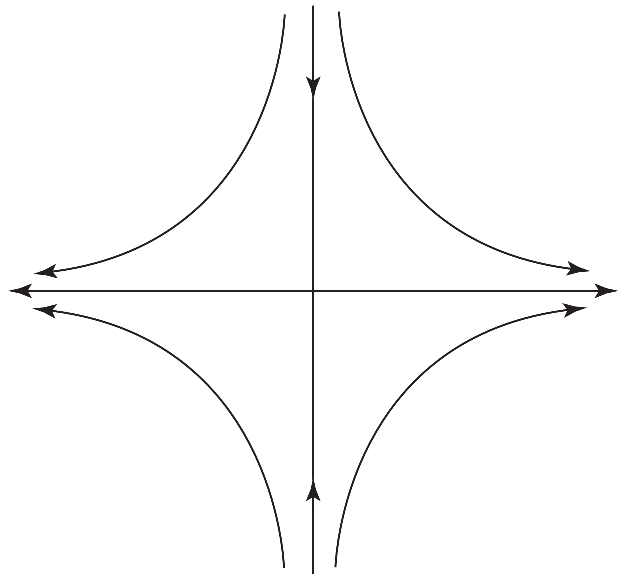


Figure 1: Phase portrait in the neighborhood of a saddle. The two separatrices are analytic curves through the singular point.

a change of coordinates given by a formal power series expansion, which we call a *formal normalizing change of coordinates*), but, except for the simplest singularities, most often these formal normalizing changes of coordinates diverge. This raises the following main questions:

Q1. Can we learn something about the equivalence problem from a divergent normalizing change of coordinates?

Q2. Why is the normalizing change of coordinates divergent? What does it mean?

Q3. In several contexts, when dealing with families of dynamical systems, we see that *divergence is the rule and convergence the exception*. Why is it so exceptional to encounter convergent normalizing change of coordinates?

Questions Q1-Q3 are receiving more and more answers. I am interested in questions Q2 and Q3. A power series diverges when its coefficients grow too fast. There are two main causes of divergence for the formal normalizing series. The first is that the process of construction of the formal normalizing series introduces some factors which grow like some powers of $n!$ in the terms of degree n. The second is that the process introduces some *small denominators* in the coefficients. The theories of k-summability, or multi-summability studied by Ecalle, Ramis, Balser and many others, allow us to solve the equivalence problem and to give a positive answer to Q1 in the first case. Coming to questions Q2 and Q3, we start having answers when the normal form is simple, for instance linear or containing a finite number of terms. This means that the normal form is very poor. It has a simple dynamics, so it is too poor. In other words, *the normal form is not sufficiently rich to encode all the possible dynamics near the singularity, hence the divergence of the normalizing series.*

Example. Consider a singular point at the origin of a planar vector field of saddle type:

$$\dot{x} = x + O(|(x,y)|^2), \quad \dot{y} = -\lambda y + O(|(x,y)|^2),$$

with λ positive. When λ is irrational, the normal form is just the linear vector field with the very simple phase portrait appearing in Figure 1. However, the formal normalizing change of coordinates converges when λ is Diophantian (i.e. badly approximated by the rationals in its continued fraction expansion) and diverges when λ is Liouvillian (i.e. well approximated by the rationals). In the latter case, the divergence comes from small denominators. Since we deal with an analytic system, all convergent series do converge for x and y on disks in $\mathbb{C}$. The ODE then provides a singular foliation in $\mathbb{C}^2$, thus allowing for complicated leaves with recurrence. When $\lambda = p/q$ is rational, the normal form is generically

$$\dot{x} = x, \quad \dot{y} = y\left(-p/q + u^k + Au^{2k}\right),$$

where $u = x^p y^q$, and the formal normalizing change of coordinates is generically divergent, but k-summable in some sense. So these forms of divergence are closely linked, and it is natural to look at systems with varying parameter λ. Some small denominators in the formal linearizing change of coordinate at an irrational value λ_1 vanish for rational values of λ, corresponding to the fact that the system is not linearizable at the singular point. If λ_2 is rational, this corresponds (generically), for λ close to λ_2, to the appearance of a very special leaf with nontrivial homology, which at λ_2 merges with the separatrices of the saddle point. The formal normal form with λ irrational is linear, and has no such leaves. If λ is Diophantian, all the special leaves escape a fixed neighbourhood of the origin, thus allowing convergence, while if λ is Liouvillian there may remain infinitely many leaves in any neighborhood of the origin, thus forbbiding convergence. This phenomenon was studied by Ilyashenko, Pyartli, and Yoccoz. Through this example we identified two more general principles:

(iv) The obstruction to the convergence of the formal normalizing transformations may only be seen when enlarging the variables in the complex domain.

(v) The obstructions are better understood when unfolding the system.

We end with the case where the formal normalizing transformations are k-summable. This occurs generically when the singularity has multiplicity $k+1$. When unfolding, we get $k+1$ simple singularities. We have local models (normal forms) near each singular point. These local models are rather rigid, and they are usually independent from each other. This forces a nontrivial gluing between the local models. If the gluing remains nontrivial up to the limit, it forces the divergence of the normalizing series. Because the local models are usually independent, nontrivial gluings rule, thus providing an answer to Q3.

Arriagada-Silva, Christopher, Mardešić, Lambert, Roussarie, Teyssier and I have recently solved the equivalence problem for families of dynamical systems in a number of cases where the formal normalizing transformations were k-summable ([1] is an accessible review). This has allowed us to explain in geometric terms the obstructions to the convergence of the normalizing series. The summability techniques do not work when the systems are unfolded, and we had to use geometric techniques. We continue our research on more complex singularities.

References

[1] C. Rousseau, Normal forms for germs of analytic families of vector fields unfolding a generic saddle-node or resonant saddle, *Nonlinear dynamics and evolution equations*, pp. 227–245, Fields Inst. Commun., 48, Amer. Math. Soc., Providence, RI, 2006.

2012 CMS Winter Meeting
December 8 - 10, 2012
Montreal, Quebec
Host: Centre de recherches mathématiques

Réunion d''hiver SMC 2012
8 – 10 décembre 2012
Montréal (Québec)
Hôte : Centre de recherches mathématiques

Scientific Director | Directeurs scientifique
Luc Vinet (Montréal), luc.vinet@umontreal.ca

Scientific Committee | Comité scientifique
Jacques Bélair (Montréal)
François Bergeron (UQAM)
John Harnad (Concordia)
Niky Kamran (McGill)
François Lalonde (Montréal)
Sabin Lessard (Montréal)
Christiane Rousseau (Montréal)
Jean-Marc Rousseau (CIRANO)

2012 CAIMS/PIMS EARLY CAREER AWARD IN APPLIED MATHEMATICS

The Canadian Applied and Industrial Mathematics Society and the Pacific Institute for the Mathematical Sciences are pleased to announce the 2012 competition for the CAIMS/PIMS Early Career Award in Applied Mathematics. The prize is to be awarded to a researcher less than ten years past the date of Ph.D. at the time of nomination. The prize recognizes exceptional research in any branch of applied mathematics, interpreted broadly. The nominee's research should have been conducted primarily in Canada or in affiliation with a Canadian university.

Nominations must be submitted by **January 31, 2012** to CAIMS/PIMS by a sponsor who is responsible for providing the following information:

- a curriculum vitae
- a publication list
- a cover letter explaining the basis of the nomination
- a maximum of three additional letters of support, at least two of which should be from references who are neither former PhD/postdoc mentors nor collaborators.

Unsuccessful nominations that continue to meet the eligibility criteria will be automatically considered for a second year.

The award will consist of a cash prize of $1,000 and a commemorative plaque that will be presented at the CAIMS Annual Meeting. The recipient will be invited to deliver a plenary lecture at the CAIMS Annual Meeting in the year of the award. A travel allowance will be provided.

Submit nominations to: nominations@pims.math.ca

Only electronic submissions will be accepted.

2012 CMS Summer Meeting
June 2 - 4, 2012
Regina Inn and Ramada Inn, Regina, Saskatchewan
Host: University of Regina

Réunion d"été SMC 2012
2 – 4 juin 2012
Hôtels Regina Inn et Ramada Inn, Regina (Saskatchewan)
Hôte : Université Regina

Plenary Speakers | Conférences plénières
Dror Bar-Natan (Toronto)
Lisa Jeffrey (Toronto)
Marius Junge (Illinois-Urbana Champaign)
Ulrike Tillmann (Oxford)

Public Lecture | Conférence publique
John Fyfe (Canadian Centre for Climate Modelling and Analysis; Victoria)

Scientific Directors | Directeurs scientifiques
Doug Farenick (doug.farenick@uregina.ca)
Don Stanley (stanley@math.uregina.ca)

Sessions

The following sessions have been confirmed:
Les sessions suivantes ont été confirmées :

Cluster Algebras and Related Topics
Algèbres amassées et sujets reliés
Org: Ralf Schiffler (Connecticut), Hugh Thomas (UNB)

Combinatorics | Combinatoire
Org: Karen Meagher (Regina), Marni Mishna (SFU)

Complex Geometry and Related Fields
Géométrie complexe et domaines reliés
Org: Tatyana Barron (Western), Eric Shippers (Manitoba)

Computation of Analytical Operators in Applied and Industrial Mathematics | Calcul des opérateurs analytiques en mathématiques appliquées et industrielles
Org: Peter Gibson (York), Michael Lamoureux (Calgary)

Connections in Mathematics Education
Connexions dans l'enseignement des mathématiques
Org: Roberta La Haye (Mount Royal), Patrick Maidorn (Regina), Kathy Nolan (Regina)

Free Probability Theory: New Developments and Applications | Théorie des probabilités libres: applications et développements récents
Org: Serban Belinschi (Saskatchewan), Benoît Collins (Ottawa)

Geometric Topology | Topologie géometrique
Org: Steve Boyer (UQAM), Ryan Budney (Victoria), Dale Rolfsen (UBC)

Geometry and Topology of Lie Transformation Groups
Géométrie et topologie des groupes de transformation de Lie
Org: Lisa Jeffrey (Toronto), Liviu Mare (Regina)

Harmonic Analysis and Operator Spaces
Analyse harmonique et espaces d'opérateurs
Org: Yemon Choi (Saskatchewan), Ebrahim Samei (Saskatchewan)

Homotopy Theory | Théorie de l'homotopie
Org: Kristine Bauer (Calgary), Marcy Robertson (Western)

Interactions Between Algebraic Geometry and Commutative Algebra | Intéractions entre la géométrie algébrique et l'algèbre commutative
Org: Susan Cooper (Central Michigan), Sean Sather-Wagstaff (North Dakota State)

Operator Algebras | Algèbres des opérateurs
Org: Martín Argerami (Regina), Juliana Erlijman (Regina), Remus Floricel (Regina)

Perspectives in Mathematical Physics
Perspectives en physique mathématique
Org: Yvan Saint-Aubin (Montréal), Luc Vinet (Montréal)

Representation Theory of Groups, Lie Algebras, and Hopf Algebras | Théorie de représentation des groupes, des algèbres de Lie et de Hopf
Org: Allen Herman (Regina), Fernando Szechtman (Regina)

Total Positivity | Positivité totale
Org: Shaun Fallat (Regina), Michael Gekhtman (Notre Dame)

Contributed Papers | Communications libres
Org: Edward Doolittle (First Nations University), Fotini Labropulu (Regina)

AARMS-CMS Graduate Student Poster Session
Présentations par affiches pour étudiants - AARMS-SMC
Org: TBD | à déterminer

IMO 2011 TEAM LEADER'S REPORT

by Dorette Pronk
Dalhousie University, Halifax

We were very grateful to have our summer training for the Canadian International Math Olympiad team at BIRS again this year. As in previous years, the hospitality and assistance of the staff were exceptional, the food was amazing, the views and hikes unsurpassed. However, Math Team Canada (Matthew Brennan, Heinrich Jiang, James Rickards, Mariya Sardarli, Alex Song and Hunter Spink) was at times so focused on solving mathematical problems and improving their skills that we had to force them to enjoy these other aspects of the camp. So most of our time was spent in a BIRS classroom in Max Bell Hall, but the beautiful surroundings were not completely wasted on our students, and they did enjoy our hikes and excursions, including an evening trip to the Banff hot springs.

For me as team leader it was a treat to form a team with returning deputy leader David Arthur and observer Jacob Tsimerman. Being able to form the same leadership team as in 2009 (for the IMO in Germany) meant that in general things ran extremely smoothly and I am grateful for the wonderful leadership and problem solving skills provided by both David and Jacob. As both David and Jacob have indicated that they are interested in continuing to be involved in the IMO I hope that we may be able to repeat this again in one of the coming years. Knowing each others' strengths takes a lot of the guess work out of the preparations. Aside from this core leadership team we also received further training help from IMO alumni Alex Fink and Farzin Barekat and other problem solving champions such as Lino Demasi and Robert Morewood (who served as team leader to the IMO in 2006). Having alumni like Alex and Farzin was very encouraging to the students, because they could share their stories of fears and victories, and remind the students to enjoy the experience.

Being close to Calgary meant that the students had an opportunity to meet with Richard Guy (thanks to Alex's parents who brought him over to have supper with us). It also meant that we received great practical assistance from Bill Sands and Peter Zvengrowski. Peter and his postdoc Debasis took us on a beautiful hike to the Consolation Lakes and some sightseeing around Lake Louise. Although the forecast had called for snow we ended up with a lovely, dry and at times even sunny, day, which was enjoyed by all.

After a truly amazing and pleasant time in Banff, it was hard for Jacob and me to have to leave a couple of days ahead of the students. However, our presence was needed in a monastery turned hotel just a bit south of Eindhoven in the Netherlands. We were greeted by old friends, and the IMO shortlist which kept us occupied until late into the night with beautiful and interesting problems. The list of combinatorics problems seemed especially interesting. Being able to discuss solutions with Jacob meant that I was much better prepared for the jury meetings over the next days, and although Jacob was not allowed to vote it was helpful to discuss the voting decisions with him. This was also his chance to become familiar with how the jury works and meet some of its members in preparation for next year's IMO in Argentina.

The jury maintained its tradition of first choosing relatively easy problems for problems number 1 and 4 (in algebra and combinatorics), and some people were at this point getting a bit worried about the level of the IMO. Those worries turned out to be misplaced as Canada was only one of a very small number of countries obtaining perfect scores on these problems. When we had settled on an inequality and a geometry problem for problems number 3 and 6, the suspense was growing among the leaders. We obviously needed a number theory problem for problem number 2 or 5, but would the last chosen problem be a geometry problem or a combinatorics problem? There were certainly some nice geometry problems left on the shortlist, but some people felt that we should honour that beautiful set of combinatorics problems by choosing a second combinatorics problem: a very unusual choice for an IMO which has traditionally always contained two geometry problems. There was a lot of discussion about the pros and cons, and I suspect that the fact that the combinatorics problem involved windmills may have just helped this problem to win by one vote for an IMO in the Netherlands! This had far reaching consequences for the students: the problem chosen is very beautiful and very unusual for an IMO, and it was clear from the scores that extra training was not necessarily going to help a student do better on this problem. For those who are now curious, let me include the problem here:

Let S be a finite set of at least two points in the plane. Assume that no three points of S are collinear. A windmill is a process *that starts with a line going through a single point $P \in S$. The line rotates clockwise about the pivot P until the first time that the line meets some other point belonging to S. This point, Q, takes over as the new pivot, and the line now rotates clockwise about Q, until it next meets a point of S. This process continues indefinitely. Show that we can choose a point P in S and a line going through P such that the resulting windmill uses each point of S as a pivot infinitely many times.*

Having chosen two combinatorics problems also meant extra complications in phrasing the problems in such a way that they would be correctly understood by the students and the translation into other languages proved to be a non-trivial exercise that required a fair amount of deliberation among jury members. Almost a full day was spent on translation and phrasing discussions.

In the meantime some jury members also worked hard on creating further alternate solutions to the chosen problems which would turn out to be invaluable in the process of creating marking schemes. Ideas that seemed only of minor importance in one solution were among the crucial steps in a different solution and this needed to be reflected in a fair grading scheme for partial solutions. The local coordinators did an excellent job at combining everything that had been brought to them during the jury meetings. Unfortunately, they were not able to do this with solutions that were brought to their attention after we joined the students in Amsterdam. During the contest David had created yet another alternate solution to one of the problems, and this solution happened to show the importance of some of the partial work that some of our students had done. However, even though we submitted this solution right away, the coordinators chose not to take this into account for the grading scheme.

Although our time in Eindhoven was very busy, there was still some time left to admire and appreciate Eindhoven as the "Brain Port" of the Netherlands through a visit to the university, and visits to various art exhibitions. Jacob and I joined the excursion to the Van Abbe Museum, a world famous museum for modern art with some very interesting architectural concepts. It also has a wall for modern art graffiti and some of the cartoons commenting on the EU were definitely thought provoking.

Jacob and I were happy to see our team, albeit from a distance, at the opening ceremony, together with their guide, Anne de Haan, who is herself an IMO-alumna from 2004 (Mexico). The opening ceremonies went generally very smoothly with an excellent music team. The parade of the countries was interspersed with break-dancers who would also guide the teams onto the stage and would unfortunately sometimes take the attention away from the students.

Problem coordination went generally very smoothly for us. This team has so far been the team with the best written solutions that I have taken to the IMO. It was generally very clear what they had accomplished for each problem and except for the issue mentioned above, we agreed with the coordinators on the number of points the solution deserved, which meant that some of us had time to go and see the new Harry Potter movie during an unexpected free afternoon.

While we filled the scoreboard with our students' accomplishments, they enjoyed their time exploring the Netherlands: sailing and visiting The Hague. They also got involved in a new contest: who would bring Canmoo on stage during the medal ceremonies? Although our mascot moose has been a contested object since the first year it came along (to Mexico in 2004) this year a serious effort was staged by the US-team to make sure that Canmoo would accompany them rather than us on the final day. So our students in turn performed some successful rescue operations in the middle of the night and took meal passes hostage to be exchanged for Canmoo when the US team would become hungry. However, the US-team did manage to steal Canmoo one last time right before the medals were being awarded. In response, our team has decided that it may be a good idea to bring a mascot for the US-team next year – that way we have something to steal from them if they decide to steal Canmoo again. In case you are wondering, Canmoo was retrieved after the medal ceremonies and is right now in Halifax.

Although this meant that Canmoo could not join us on stage, we were very proud and delighted that each one of our student team members was invited on stage to receive a medal. Alex received a gold medal, a wonderful accomplishment at the age of 14; James and Hunter received silver medals, and Mariya, Matthew, and Heinrich received bronze medals (the silver cutoff was unfortunately such that Mariya and Matthew went home with the highest score for a bronze medal).

A wonderful highlight of the medal ceremonies was that Lisa Sauermann from Germany scored her fourth and final gold medal (her fifth medal in total – the first one was silver), and she did this with a perfect score of 42 points. This means that right now she is leading the IMO hall of fame replacing her fellow German contestant Christian Reiher, who was there to congratulate her. This brought up some discussion about the results of female contestants at the IMO. It is interesting that although the number of women participating is lower than the number of men, their scores are statistically comparable.

I discussed this with one of my Dutch colleagues, and he remarked that in his courses at the Technical University in Eindhoven, women, although in the minority, tend to produce better results. He was wondering whether this means that in society the bar to enter a technical or scientific program is set higher for women than for men, whereas this is not the case for the IMO. I am wondering whether this difference might also be related to different work habits and confidence levels between male and female students, where at the IMO everybody is equally focused.

After the students had been informed of their scores and we had decided on the medal cutoffs, the jury started the discussion of a very complicated and sensitive issue. This was the 52nd IMO and although the number of countries participating has grown drastically, and our society and ways of communicating have changed significantly, this competition is still run in pretty much the same way that it was run in the 1950s. Over the past ten years there have been a couple of times when a team was found guilty of cheating and this was very embarrassing and painful for all involved. This has not happened over the past couple of years, but for some team leaders this doesn't mean that there have not been suspicions. They are not happy with the fact that we are in some sense relying on an honour code and would like to ensure that cheating cannot happen. And this is specifically about cheating through a leader who communicates problems or solutions with his or her team members before the contest. One of the solutions discussed was to have the whole contest set by a committee, which is larger than the current problem selection committee, but does not involve the leaders of the teams. This way the leaders do not need to come earlier anymore, they can arrive together with their teams, and just need to get up early on the morning of the contest to translate the papers into their own language.

Although this was a good way to get a discussion about this very important issue started, this solution has a lot of drawbacks and did not get the support of the majority of the jury. One of the general issues with this solution is the fact that the jury meeting time is also our time to discuss the status of mathematics and math education in various countries and to spend some time networking so that we can help each other improve the situation in various African and Middle Eastern countries, for instance. Also, in the interest of the IMO competition, there are some very valuable aspects to the jury time that have contributed to making this a high quality contest.

First, the leaders have the experience of trying the short-listed problems without solutions so that they can experience the problems the way the students will. This is important, because the existence of a short solution does not necessarily mean that a problem is easy for the students. One needs to take into account how easy it is to come up with the core idea for the solution.

Another aspect is the fact that phrasing the problems properly and translating them may take longer than the two or three hours scheduled for this early in the morning of the day of the contest. Within this framework there is no time to check on everybody's translations as we do now and this may cause much more inequality among the students.

Furthermore, with this way of proceeding there will not be a lot of time for leaders to create alternate solutions before we decide on a grading scheme. As we saw again at this competition, the leaders' contributions to the list of solutions for the problems were invaluable in setting a fair marking scheme.

Finally, if one is skeptical, this solution does not solve the problem: even if the leaders have no access to solutions, a text-message with the problems will give a team enough of a head start to solve one or more problems together (these are smart students after all). So although integrity is crucial, and we need to continue to review the way we do things, I think that it is equally important to work on improving the relationships among the leaders, so that this is a community where we don't want to cheat and where we can trust each other and where we have an appropriate mechanism for discussing and following up on suspicions. If any of our readers have suggestions for how we may be able to do things differently, please contact our IMO chair Robert Morewood (RMorewood@olc.ubc.ca), next year's team leader Jacob Tsimerman (jtsimerm@princeton.edu), or me (pronk@mathstat.dal.ca). The discussion on this topic is ongoing and the IMO Advisory Board does welcome all input. Solving this problem will require problem solving skills of a different kind than those needed to write an IMO, and the collaboration of a committed community.

2012 Doctoral Prize

The CMS Doctoral Prize recognizes outstanding performance by a doctoral student. The prize is awarded to a candidate who received a Ph.D. from a Canadian university in the preceding year (January 1st to December 31st) and whose overall performance in graduate school is judged to be the most outstanding. Although the dissertation is the most important criterion (the impact of the results, the creativity of the work, the quality of exposition, etc.) other publications, activities in support of students and other accomplishments will also be considered.

Nominations that were not successful in the first competition will be kept active for a further year (with no possibility of updating the file) and will be considered by the Doctoral Prize Selection Committee in the following year's competition.

The CMS Doctoral Prize consists of a $500 award, a two-year complimentary membership in the CMS, a framed Doctoral Prize certificate and a stipend for travel expenses to attend the CMS meeting to receive the award and present a plenary lecture.

Nominations

Candidates must be nominated by their university and the nominator is responsible for preparing the documentation described below, and submitting the nomination to the Canadian Mathematical Society. No university may nominate more than one candidate.

The documentation shall consist of:

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

The deadline for the receipt of nominations is **January 31, 2012**. All documentation, including letters of recommendation, must be submitted electronically to docprize@cms.math.ca.

Prix de doctorat 2012

La SMC a créé ce Prix de doctorat pour récompenser le travail exceptionnel d'un étudiant au doctorat. Le prix sera décerné à une personne qui aura reçu son dipôme de troisième cycle d'une université canadienne l'année précédente (entre le 1er janvier et le 31 décembre) et dont les résultats pour l'ensemble des études supérieures seront jugés les meilleurs.

La dissertation constituera le principal critère de selection (impact des résultats, créativité, qualité de l'exposition, etc.), mais ne sera pas le seul aspect évalué. On tiendra également compte des publications de l'étudiant, de son engagement dans la vie étudiante et de ses autres réalisations.

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

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

Candidatures

Les candidats doivent être nommés par leur université; la personne qui propose un candidat doit se charger de regrouper les documents décrits aux paragraphes suivants et de faire parvenir la candidature à la Société Mathématique du Canada. Aucune université ne peut nommer plus d'un candidat.

Le dossier sera constitué des documents suivants :

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

Les candidatures doivent parvenir à la SMC au plus tard le **31 janvier 2012**. Veuillez faire parvenir tous les documents par voie électronique avant la date limite à prixdoc@smc.math.ca.

DU BUREAU DU DIRECTEUR ADMINISTRATIF

Johan Rudnick
Société mathématique du Canada

UNE LOI QUI NE SERA PAS FORCÉMENT FACILE À RESPECTER

La nouvelle *Loi canadienne sur les organisations à but non lucratif* est entrée en vigueur le 17 octobre 2011. Les organismes de bienfaisance comme la SMC auront jusqu'au 17 octobre 2014 pour se conformer aux nouvelles exigences touchant les règlements administratifs et à d'autres exigences en matière de conduite et de présentation de rapports divers. Avant la date d'entrée en vigueur de la nouvelle loi, les organismes de bienfaisance peuvent choisir de s'adapter à la loi selon les besoins ou, en gros, opter pour une refonte complète. Comme organisation nationale mûre et bien établie, la SMC semble déjà se conformer à une grande partie des dispositions de la nouvelle loi. Cependant, après 12 ajustements aux règlements administratifs d'origine proposés il y a 30 ans et plus déjà, l'occasion est peut-être toute indiquée pour la SMC d'envisager de nouveaux règlements administratifs.

Les règlements administratifs de la SMC

La nouvelle loi offre aux organismes de bienfaisance des règlements administratifs implicites, qui sont essentiellement des règlements prédéfinis. En appliquant ces dispositions implicites, les organisations peuvent se doter de règlements administratifs beaucoup plus simples, voire minimalistes. Selon la nouvelle loi aussi, les règlements administratifs n'ont plus qu'à être déposés. On n'exige plus qu'Industrie Canada en fasse l'examen avant de les approuver. Bien que les règlements administratifs assurent le fonctionnement de l'organisation à divers égards, une partie de l'orientation générale de la SMC est vieillie et présente quelques défis d'ordre fonctionnel. Une refonte des règlements administratifs permettrait à la SMC de se doter de pratiques exemplaires et de technologies nouvelles et à jour, tout en adoptant le principe de la souplesse fonctionnelle.

Les activités de la SMC

Selon la nouvelle loi, les organismes de bienfaisance tels que la SMC se voient conférer les mêmes droits que les sociétés par actions et peuvent entreprendre des activités commerciales et non commerciales. Il reste à établir dans quelle mesure une activité de la SMC telle que la publication de revues spécialisées peut être transformée en une activité commerciale. Il faut noter toutefois que même si la loi autorise les activités commerciales, ces activités peuvent enfreindre les règlements fiscaux régissant les organismes de bienfaisance et seraient alors assujetties à leurs contraintes.

Les responsabilités des administrateurs et des dirigeants de la SMC

La nouvelle loi confère aux administrateurs et aux dirigeants de la SMC les mêmes responsabilités en matière de diligence et de loyauté à l'égard de la loi qu'ont ceux d'une entreprise et impose des exigences de conformité par rapport aux conflits d'intérêt. Vu les pratiques actuelles de la SMC et sa nouvelle politique sur les conflits d'intérêt, la conformité aux exigences liées aux responsabilités et aux conflits d'intérêt ne devrait poser aucun problème pour l'organisation.

Le Conseil d'administration de la SMC

Selon la nouvelle loi, au moins trois administrateurs doivent siéger au Conseil d'administration – la SMC compte 33 membres votants, sans compter les autres participants. À titre de comparaison, la taille du Conseil d'administration de la SMC est bien plus importante que celle du conseil de l'Association médicale canadienne ou du Conseil de la Ville d'Ottawa et est pratiquement le double de celle du Conseil d'administration du CRSNG. La nouvelle loi permet également d'organiser des réunions du conseil qui se dérouleront à distance, par téléconférence, et de réaliser des activités par résolution écrite. Vu la taille du Conseil d'administration de la SMC, il est difficile d'envisager d'organiser des conférences téléphoniques. Selon les règlements administratifs en vigueur, obtenir l'approbation des résolutions écrites (électroniques) de la part du Conseil d'administration n'a pas été la marche à suivre préconisée parce qu'en général les délais de réponse font échouer le processus. L'approbation des résolutions par le Comité exécutif toutefois, soit les questions pour lesquelles le vote n'est assujetti à aucune contrainte de temps, est une activité qui se prête bien à ce processus.

Les droits des membres de la SMC

La loi vient renforcer les droits de tous les membres. Un membre a maintenant le droit de présenter un avis de proposition concernant une question à présenter au cours d'une réunion des membres (p. ex. l'Assemblée générale annuelle); un membre peut demander qu'on convoque une réunion et a le droit d'accès aux dossiers internes. Selon les règlements administratifs en vigueur à la SMC, les membres peuvent proposer des questions à poser au cours des réunions et demander qu'on tienne une réunion (avec l'appui de 29 autres membres). En pratique, la SMC rend public, à tous les ans, des états financiers vérifiés. La nouvelle loi autorise aussi maintenant la séparation des votes de membres non votants dans certaines circonstances. Bien que la SMC ne compte aucun membre non votant, si l'on crée des catégories de membres affiliés et associés, il faudra tenir compte des droits et des intérêts des membres de ces catégories.

Dans le cadre de ses améliorations aux droits des membres, la loi garantit certaines protections qu'on peut imposer par des poursuites en justice. Par exemple, la cour peut exiger une enquête sur les mauvais agissements allégués ou exiger que l'organisation partage ou divulgue de l'information. Dans l'ensemble, les droits des membres stipulés par la loi ont été caractérisés comme étant semblables à ceux des actionnaires d'entreprises et, par conséquent, devront faire l'objet d'une prise en compte et d'un soin plus étroits.

Obligations organisationnelles de la SMC

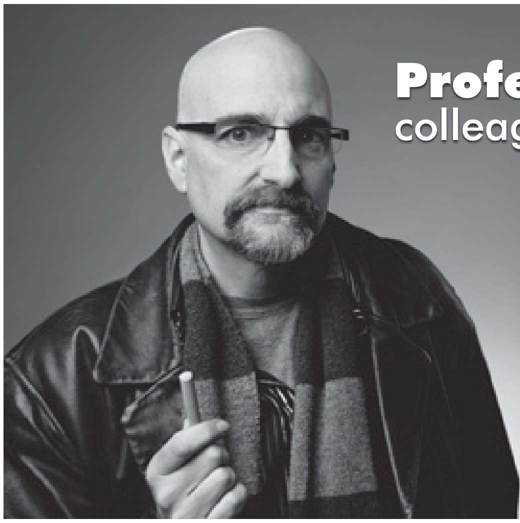
Selon la nouvelle loi, l'organisation doit organiser une rencontre annuelle et est tenue de respecter certaines exigences en matière de présentation de rapports annuels. Selon ses règlements administratifs, la SMC doit déjà tenir une réunion annuelle. Selon ses pratiques actuelles, l'organisation répond déjà aux exigences de la loi en matière de présentation de rapports. Selon la nouvelle loi, les administrateurs et les membres de la SMC jouissent de certains droits leur permettant d'approuver les « changements fondamentaux » stipulés à l'organisation, y compris les changements aux règlements administratifs, aux conditions d'adhésion et aux activités et à la mission de l'organisation; pour la SMC, ces types de changements relèvent de l'autorité de son Conseil d'administration et de ses membres (au cours d'une réunion des membres).

Un cadre de gouvernance moderne pour la SMC

La plupart des dispositions de la loi tendent à favoriser un cadre juridique organisationnel moderne pour les organismes de bienfaisance enregistrés au niveau fédéral. Pour les organisations mûres telles que la SMC, la conformité à la loi ne devrait pas être problématique. En effet, il semblerait que la SMC répond déjà à la plupart sinon à toutes les exigences en matière de conformité à la loi. Même s'il serait plus simple de chercher à adopter une démarche axée sur le statu quo vis-à-vis de la loi, certains facteurs laissent entrevoir que la SMC pourrait être contrainte de changer.

À titre d'exemple, à une époque où l'on vote par voie électronique, faut-il toujours quatre semaines pour voter et recourir à des scrutateurs pour compter ces voix? Vu le cadre et la souplesse que confère la loi, il faut se demander s'il est toujours nécessaire de prescrire la façon de faire quelque chose ou ce qu'on doit faire plutôt que de tout simplement exiger la conformité à la loi. En ce qui concerne la taille du Conseil d'administration, songez au fait que la SMC compte suffisamment de membres de conseil pour répartir ces derniers et régir, tout au moins, 11 organismes de bienfaisance, au besoin – soit bien plus évidemment que les trois qu'il faut, selon loi, pour gérer la SMC. Toutefois, 33 pourrait être un peu trop!

Après 30 ans de réparations et vu les réparations qu'il reste à apporter et la nouvelle loi à respecter maintenant, le moment est peut-être venu de bâtir un nouvel ensemble de règlements administratifs modernes pour la SMC.



Professor Robbie Charles Fry:
colleague, teacher, mentor, friend, mathematician.

" Robb will be remembered for his mathematics, his music, his humour, and his incredible courage over the last six months. Most of all, Robb will be remembered for his warmth so evident in his love of his family, particularly his daughter that brought so much joy to his life."

Photo by Tyler Stalman

On Aug 31, 2011, Robb Fry passed away after a lengthy battle with cancer. Robb was an undergraduate at Queen's University, studying both mathematics and physics. Although he ultimately decided upon a career in mathematics, his early interest in physics persisted all his life. After a short period as a graduate student at the University of Alberta, Robb completed his doctorate in mathematics under Chandler Davis at the University of Toronto. His first appointment was at the College of New Caledonia in Prince George, BC, followed by five years at the University of Northern British Columbia, playing a key role in the development of the mathematics department at that then new institution. At UNBC he quickly earned a reputation as an excellent and entertaining lecturer as well as an indefatigable organizer of social events. The opportunity of a tenure-track appointment led him across the country to Saint Francis Xavier University. He returned to the west to accept an appointment at Thompson Rivers University in 2006 and was promoted to Professor there in 2010.

Anyone who knew Robb knew his passion for mathematics. He continued to work and publish until the very end of his life. He was highly respected for his work on approximation and extension in Banach spaces. Banach space theory is not an especially active research area in Canada, with Spain and the Czech Republic being the main centres of activity. Robb tried to change this, and organized CMS sessions on the topic. Much of Robb's work was co-operative, with co-authors in both Canada and Spain.

However, his knowledge of mathematics extended far beyond his area of specialization. To chat with Robb about things mathematical over coffee, or a decent glass of red wine, was a special experience. Robb had a particular ability to present complex mathematics in a clear and engaging way. This was true of his most recent research. It was true of first year Calculus. His courses in analysis, history of mathematics, and measure theory were highlights for many students. It is no surprise that the student organizers of the Canadian Undergraduate Conference in Mathematics/Congrès Canadiendes Étudiants en Mathématiques 2009 chose Robb as a keynote speaker. His talk on Bertelmann's Socks (LesChaussettes de M. Bertelmann Révisité) complete with washing machines was a big hit.

Robb will be remembered for his mathematics, his music, his humour, and his incredible courage over the last six months. Most of all, Robb will be remembered for his warmth so evident in his love of his family, particularly his daughter that brought so much joy to his life.

We miss him greatly.

Dr. Richard Brewster
Chair, Department of Mathematics and Statistics
Thompson Rivers University

In Memory: Dr. Robb Fry
By John Quinn, Joe Apaloo and Sergei Aalto

Our colleague and friend Dr. Robb Fry passed away on August 31, 2011. He was Professor of Mathematics at Thompson Rivers University, and formerly taught at the University of Northern British Columbia and St. Francis Xavier University (StFX). A graduate of Queen's University with a PhD from the University of Toronto, Robb was an active researcher in real analysis and approximation theory. His research was funded by an NSERC Discovery Grant throughout his career. To his friends at StFX he was known as someone who always welcomed a visit to his office, particularly if they had a challenging question about real analysis. Dr. Fry was a teacher whose love of mathematics was apparent and who had a real talent to convey both the meaning of mathematics and the excitement of doing mathematics to his students.

Rob was an excellent entertainer. While at StFX, he often held dinners and lunches at his home to which many work colleagues and friends were invited. He held these parties for the pure love of getting people together. In the hallway of his home department at StFX and in his office, Robb was always cheerful and welcoming. In his own words, Antigonish and StFX was the place where his marriage, fatherhood and career began. While he lived in Kamloops , British Columbia he would provide accommodation and meals for friends from Antigonish who visited at his house, and thus he maintained the friendships he had established while he lived in Antigonish. He is greatly missed by his wife Pamela, daughter Georgia, and his friends in the mathematics community.

To a friend

By Matthias Neufang

Of all articles I have ever written, this was the hardest to compose. It is a note of good-bye to Robb Fry, whom I had the privilege to call my friend, and who passed away on August 31, 2011. I could not say good-bye to him in person – few days before he died, his wife Pamela called me from BC in my office at Fields: she said Robb had been taken again to the hospital, but could not speak on the phone anymore since the cancer had attacked his brain. I was terribly upset, but we both spoke about how much he had enjoyed the few hours the three of us had been able to spend together in June in Edmonton, at the summer CMS meeting, Robb's last trip.

I had first met Robb at a conference in Paseky, a Czech version of Oberwolfach, and a paradise for those who love eating Knödel or drinking beer or discussing mathematics – or a combination thereof, as Robb and I did. We found very quickly that we not only shared a great passion for mathematics – which is fairly obvious from the fact that we both travelled from Canada to a village over 100km from Prague to study nonseparable Banach spaces – but also the same sense of humour. It is these qualities which made us become friends, and they have always stayed with Robb, till the end of his all-too-short life. I am grateful for the years I could meet him, as a visitor or at conferences, and I could count on receiving an unexpected phone call from Kamloops, mostly in the evening, in my office at Carleton and later at Fields. I will never forget the many hours of joyful discussion, about mathematics, life and anything there is between the two.

In June in Edmonton, after one of the few lectures Robb could attend, and after returning to his hotel room to rest, he would still explain to me his idea of generalizing his latest result from the separable to the weakly compactly generated case, and outline an ambitious project which, as he said, he was not going to live long enough to complete. He was lying down, had trouble speaking, and his words were often interrupted by coughing. And yet, the lung cancer could not stop him from telling a friend about his latest finding – and to tell it with unbreakable enthusiasm! This last conversation I had with Robb, at hindsight, was also a lesson on the tremendous power of our passion, mathematics. This is to you, Robb!

Committee, the voting for which is not time constrained, has worked quite well.

The Rights of CMS Members

The *Act* enhances the rights of all members. A member now has the right to submit a notice of proposal for an issue to be presented at a meeting of members (i.e. the Annual General Meeting); the member can requisition a meeting; and the member has a right to access corporate records. Under existing CMS bylaws, members can submit meeting item proposals as well as requisition a meeting (with the support of 29 other members). In practice, CMS now publically posts annual audited financial statements. The new *Act* also allows for segregated voting by non-voting members in some circumstances; while CMS does not have any non-voting members, if affiliate and associate membership categories are developed, then their rights and interests will have to be considered.

As part of the enhancements to member rights, the *Act* provides for certain protections that can be exercised through court action. For example, the court can order an investigation into alleged wrongdoing or force the organization to share (disclose) information. Taken as whole, the member rights stipulated by the *Act* have been characterized as akin to those of corporate shareholders and, as such, will require greater care and consideration.

CMS Corporate Obligations

The new *Act* requires an annual meeting as well as certain annual filing requirements. The CMS bylaws already provide for an annual meeting and CMS practices already meet the filing requirements of the *Act*. The new *Act* also stipulates that directors and members have certain rights to approve stipulated 'fundamental changes' to the organization, including changes to bylaws, membership conditions, corporate activities, and mission; for the CMS, these types of changes come under the purview of the CMS Board and members (at a members meeting).

A Modern CMS Governance Framework

Much of the *Act* is directed at nurturing a modern corporate law framework for federally registered charities, and for mature organizations like the CMS, compliance with the *Act* should not be an issue. Indeed, much if not all of the compliance requirements of the *Act* essentially appear to be already met by the CMS. While it would be easy to pursue a status quo approach in responding to the *Act*, there are some considerations that suggest CMS may need a change.

Consider, as an example, that in the age of electronic voting, is it still necessary to have four weeks to vote and use tellers to count those votes? Given the framework and flexibility provided by the *Act*, consider whether it is still necessary to prescribe what and how something is to be done rather than simply direct compliance with the *Act*. As to Board size, consider that the CMS has enough board members to spread around and minimally govern 11 charities, if need be – clearly more than three are needed to govern the CMS, however, 33 may be just a bit too much!

After 30 years of fixing, with some repair yet to be done, and now with a new *Act* to follow, it might just be the right time to build a new set of contemporary bylaws for the CMS.

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

2012

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

Nominations should include a reasonably detailed rationale and be submitted by **March 31, 2012**.

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

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

Pour les mises en candidature prière de présenter des dossiers avec une argumentation convaincante et de les faire parvenir, le **31 mars 2012** au plus tard.

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

MATHEMATICS OF PLANET EARTH COMPETITION FOR AN OPEN SOURCE EXHIBITION OF VIRTUAL MODULES

www.mpe2013.org/competition

This competition is part of the world initiative "Mathematics of Planet Earth 2013" (MPE2013): www.mpe2013.org

The modules could be reproduced and utilized by many users around the world from science museums to schools under one of the following licenses

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The exhibition will have a virtual part as well as instructions to realize material parts. Examples of modules or themes to be covered are available on the website

To stimulate imagination on the many domains where mathematics plays a crucial role in planetary issues the following four themes are proposed, but these themes are not exhaustive:

- **A PLANET TO DISCOVER:** oceans; meteorology and climate; mantle processes, natural resources, celestial mechanics

- **A PLANET SUPPORTING LIFE:** ecology, biodiversity, evolution

- **A PLANET ORGANIZED BY HUMANS:** political, economic, social and financial systems; organization of transport and communications networks; management of resources; energy

- **A PLANET AT RISK:** climate change, sustainable development, epidemics; invasive species, natural disasters

The typical modules submitted to this competition can be of four forms and should have some scientific explanations for the public:

- A module explaining how to realize a physical module in a museum.
- An interactive exhibit to be watched either on the web or in a museum.
- A film.
- Image(s)

COMPETITION PERIOD, JURY, PRIZES

The competition will be open from January 2012 to May 15, 2012.

The prize winners will be selected by an international jury nominated by MPE2013. The prize winners will be announced in August 2012. The judges' decision will be final.

The first, second and third prize winners will receive respective prizes of US$ 5000, US$ 3000 and US$ 2000. The winning modules will occupy a prominent place on the website of the exhibition. Moreover it is planned to show the modules of the overall winners in exhibitions and museums.

COMPÉTITION "MATHÉMATIQUES DE LA PLANÈTE TERRE" POUR UNE EXPOSITION OPEN SOURCE DE MODULES VIRTUELS

www.mpt2013.org/competition

Cette compétition fait partie de l'initiative "Mathématiques de la planète Terre 2013" (MPT2013) : www.mpt2013.org

Les modules pourront être reproduits et utilisés par des utilisateurs de partout dans le monde, des musées scientifiques aux écoles sous une des deux licences:

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L'exposition aura une partie virtuelle, ainsi que des instructions pour réaliser des modules physiques. Des exemples de modules ou de thèmes potentiels de modules sont disponibles sur le site.

Pour stimuler l'imagination sur les nombreux domaines où les mathématiques jouent un rôle dans les enjeux planétaires, on propose quatre thèmes (non exhaustifs):

- **UNE PLANÈTE À DÉCOUVRIR** : océans; météorologie et climats; processus dans le manteau terrestre; ressources naturelles; mouvements planétaires

- **UNE PLANÈTE RICHE SUR LE PLAN BIOLOGIQUE** : écologie, biodiversité, évolution

- **UNE PLANÈTE FAÇONNÉE PAR LA CIVILISATION** : systèmes politiques, économiques, sociaux et financiers; réseaux de transports et de communications; gestion des ressources; énergie

- **UNE PLANÈTE EN DANGER** : changements climatiques; développement durable, épidémies, espèces invasives, désastres naturels

US$

Les modules typiques soumis à cette compétition peuvent être de 4 formes et doivent contenir des explications pour le public:

- Un module expliquant comment réaliser un module physique dans un musée
- Un module interactif pouvant être regardé sur le web ou dans un musée
- Un film
- Des image(s)

PÉRIODE DE LA COMPÉTITION, JURY, PRIX

La compétition sera ouverte de janvier 2012 au 15 mai, 2012.

Un jury international nommé par MPT2013 choisira les gagnants qui seront annoncés en août 2012. La décision des juges sera finale.

Les montants des premier, deuxième et troisième prix seront de 5000 US$, 3000 US$ et 2000 US$. Les modules gagnants occuperont une place en vue sur le site de la compétition. De plus, il est prévu de les exposer dans des expositions et musées.

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

DECEMBER 2011 DECEMBRE

5 – 9 Stability, hyperbolicity, and zero localization
(Amer. Inst.of Math, Palo Alto, CA)
http://aimath.org/ARCC/workshops/hyperbolicpoly.html

10 – 12 **CMS Winter Meeting**
Ryerson University and York University, Toronto, ON
www.cms.math.ca

15 – 17 Applied Mathematics & Stochastic Processes
(Sacred Heart College, Chennai, India)
www.shctpt.edu

17 – 18 International Conference on Math Sciences and Applications
(New Delhi, India)
http://ijmsa.yolasite.com/conference-announcement.php

JANUARY 2012 JANVIER

4 – 7 AMS Joint Mathematics meetings (Boston, MA)
www.ams.org/meetings/national/jmm/2138_intro.html

9 – 13 AIM Workshop: Mapping theory in metric spaces
(Palo Alto, CA)
http://aimath.org/ARCC/workshops/mappingmetric.html

23 – 27 Set Theory and C*-algebras
(Amer. Inst.of Math, Palo Alto, CA)
http://aimath.org/ARCC/workshops/settheorycstar.html

FEBRUARY 2012 FÉVRIER

13 – 17 ICERM Workshop: Complex and p-adic Dynamics
(Providence, RI)
http://icerm.brown.edu/sp-s12/workshop-1.php

16 – 18 Conference on Advances in Control and Optimization of Dynamical Systems (ISI, Bangalore, India)
www.acods.org

20 – 24 AIM Workshop: Stochastic Dynamics of small networks of neurons (Palo Alto, CA)
http://aimath.org/ARCC/workshops/neuronnetwork.html

MARCH 2012 MARS

3 – 4 American Math Society Meeting
(Univ. of Hawaii at Manoa, Honolulu)
www.ams.org/amsmtgs/sectional.html

12 – 16 Classifying fusion categories
(Amer. Inst.of Math, Palo Alto, CA)
http://aimath.org/ARCC/workshops/fusioncat.html

17 – 18 American Math Society Meeting
(George Washington Univ. Washington, Dist. Columbia)
www.ams.org/amsmtgs/sectional.html

25 – 28 Partial Differential Equations and Applications (Hanoi, Vietnam)
http://aimath.org/ARCC/workshops/neuronnetwork.html

APRIL 2012 AVRIL

16 – 20 ICERM Workshop: Moduli Spaces associated to Dynamical Systems (Providence, RI)
http://icerm.brown.edu/sp-s12/workshop-3.php

23 – 25 Conference on Analytical Approaches to Conflict (Royal Military Acad.,Sandhurst, UK)
www.ima.org.uk/conferences/conferences_calendar/influence_and_conflict.cfm

MAY 2012 MAI

20 – 27 European Conference on Elliptic and Parabolic Problems
(Gaeta, Italy)
www.math.uzh.ch/gaeta2012

28 – June 3 Theory of Approximation of Functions and Applications
(Kamianets-Podilsky, Ukraine)
www.imath.kiev.ua/~funct/stepconf2012/en/

JUNE 2012 JUIN

2 – 4 **CMS Summer Meeting**
University of Regina, Regina, SK
www.cms.math.ca

17 – 24 50th International Symposium on Functional Equations
(Hajdúszoboszló, Hungary)
pales@math.unideb.hu

JULY 2012 JUILLET

2 – 6 24th Conference on Operator Theory,
(West Univ. Timisoara, Roumania)
http://www.imar.ro/~ot/

9 – 15 10th International Conference on Fixed Point Theory and Applications (Cluj-Napoca, Romania)
www.cs.ubbcluj.ro/~fptac/

16 – 20 HPM 2012 History and Pedagogy of Mathematics - The HPM Satellite Meeting of ICME-12 (Daejeon, Korea)
www.hpm2012.org

23 – 27 Algebraic Topology: applications and new directions
(Stanford U, Palo Alto, CA)
http://people.maths.ox.ac.uk/tillmann/StanfordSymposium.html

AUGUST 2012 AOÛT

26 – 31 XXVIth International Biometric Conference Kobe International Conference Center (Kobe, Japan)
http://secretariat.ne.jp/ibc2012/

SEPTEMBER 2012 SEPTEMBRE

20 – 22 Lie and Klein: the Erlangen program and its impact on mathematics and physics (Strasbourg, France)
www-irma.u-strasbg.fr/article1173.html

DECEMBER 2012 DÉCEMBRE

2 – 4 **CMS Winter Meeting**
Montréal, QC
www.cms.math.ca

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Issue date/ date de parution	Content deadline / Date limite pour contenu
February / février	December 1 / le 1 décembre
March/April / mars/avril	January 28 / le 28 janvier
June / juin	March 30 / le 30 mars
September / septembre	June 30 / le 30 juin
October/November / octobre/novembre	August 30 / le 30 août
December / décembre	September 29 / le 29 septembre

Net rates / tarifs nets	Institutional Members / Library Membres institutionnels / Bibliothèques	Corporate Members Membres Organisationels	Others/Autres
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3/4 page	240.00	445.00	595.00
1/2 page	160.00	295.00	395.00
1/4 page	95.00	175.00	235.00
Back cover	325.00	615.00	815.00
Inserts	195.00	375.00	495.00

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Des suppléments sont applicables pour des places de choix - communiquer avec notes-ads@smc.math.ca. L'adhesion à la SMC comprend l'abonnement aux Notes de la SMC. Le tarif d'abonnement pour les non-membres est de 82 $ CDN si l'adresse de l'abonné est au Canada et de 82 $ US si l'adresse est à l'étranger.

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