CMS NOTES de la SMC

IN THIS ISSUE
DANS CE NUMÉRO

FROM THE VICE-PRESIDENT'S DESK

Jason I. Brown
Dalhousie University, Halifax

Westward, Ho!

I haven't always been discrete. I undertook my undergraduate degree at the University of Calgary, not knowing what I wanted to focus my studies on. The combination of liking mathematics and hating lab work pushed me towards the math side of science. During my second year, Robert Woodrow, my calculus professor, suggested I apply for a summer to NSERC to work on a research project. Research in mathematics? It was something I haven't really thought about previously. Robert suggested I look at graphs, and all I could think about was the kind of plots I had seen and drawn in calculus. What could be new or interesting about those?

I was way off base, which I soon discovered when Robert dropped the classic book by Bondy and Murty *Graph Theory with Applications* on me (it only hurt for a short time). I worked through the book quickly that summer, and fell in love with graphs, networks and all things discrete. I soon began working on a research problem on graph colourings, and found that I could indeed find brand new results.

In the early eighties the mathematics department at the University of Calgary was rather unique, being a vortex of activity in discrete mathematics. It seemed that there were several seminars each week in discrete mathematics, and many in the department who were busy researching in the area - Woodrow, Sands, Rival, Milner, Guy, to name but a few. And it seemed that those whose area of research lay outside the realm of combinatorics were drawn towards it in weird and wonderful ways. (I remember distinctly a talk by the algebraist Hanafi Farahat who, with combinatorialist Norbert Sauer, had applied algebra to understand and explore a problem on degrees in a graph. The idea that one could apply a seemingly unrelated area to another in a deep, mysterious and ultimately meaningful way has never left my thoughts.)

There was perhaps no one better at seeing such connections than Paul Erdös, whom I had the privilege of meeting back then. It seemed that everyone who was anyone in discrete mathematics visited the department. Paul Erdös was of course revered when he visited, and one time he chose to take me, a mere ε at the time, out to lunch, just the two of us. I had known and I was told of Erdös's work, and was fairly quiet at lunch. He drew me out, and it was wonderful to speak with him, about mathematics, but also about life in general.

I also remember Erdös wanting to go to a nearby plaza to get his hair cut, so I happily walked with him. The intersection for the plaza was always incredibly busy and, like everything in Calgary, very large. Abstract concepts in mathematics obviously were very concrete to Erdös, but I found out then that, conversely, traffic lights and cars and trucks traveling at high speeds were to be considered abstract. Erdös walked across traffic intersections against the lights, and I trailed behind with a prayer. I would hate to be the young mathematician who would forever be known as the one who was with Paul Erdös when he died crossing the road. But as I followed behind I had realized that he had obviously done this many, many times over his life, without serious incident. It was I who needed to be worried!

A final episode filled that day. Paul Erdös wanted me to accompany him to the library to find an old paper of his in order to recall the details of a result. He had an idea of what journal and volume number it was, so as he browsed the book shelves, he sent me off to fetch it. The series numbers for the journal stopped before the number he had suggested, and when I returned empty-handed, he grew impatient with me. I said nothing, but when Erdös checked the bookshelves himself and found what I had found, he turned to me and apologized. The great Erdös apologized to me, a lowly ε. I learned that day that a great

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EDITORIAL

by S. Swaminathan
Dalhousie University, Halifax

Lucubrations on Proof.

At the December 2006 meeting in Toronto, the popular lecture was by V. Kumar Murty. He gave a very interesting talk on 'What is proof?' It was well-received and was a conversation piece at informal gatherings of members. A non-mathematician expressed her appreciation of the talk and asked why Fermat didn't write out his truly marvelous proof on a sheet of paper. She was told that Fermat did mathematics more as a hobby and wrote only letters to other mathematicians concerning his problems. I suggested that she should read Simon Singh's *Fermat's Enigma* where such matters are dealt with.

The conversation turned next to the length of proofs - is Andrew Wiles's proof of Fermat's Last Theorem the longest? The two papers giving the proof in the 1995 *Annals of Mathematics* take up 130 pages. But the proof of the second Burnside Conjecture on solvability of groups of odd order is 254 pages long and comprised a whole issue of the 1963 *Pacific Journal of Mathematics*. What about shortest proofs? Well, it can be even just one sentence. For example, *A one-sentence proof that every prime p congruent to 1(mod 4) is a sum of two squares*, by D. Zagier, appears in the *Amer. Math. Monthly*, 97 (1990), 144.

There are also instances of simplifications of complicated proofs. Gauss' first proof of the quadratic reciprocity law is quite complicated to understand. Ezra Brown has presented a modern version of this proof in the *American Math. Monthly* 88, 1981, 257-264. There are more than 150 proofs of this law.

Irving Kaplansky possessed a knack of producing simple proofs. The *problème de ménages* asks for the number of ways of seating *n* husbands and *n* wives at a circular table, men alternating with women, so no husband sits next to his wife. Considerable literature has been devoted to this problem. Kaplansky published a very simple solution based on a couple of lemmas (which are interesting in themselves) on permutations and combinations (*Bulletin AMS* 49 (1943) 784-785).

P. R. Halmos relates an anecdote in his review (*Amer. Math. Monthly* 88, 1981, 451) of a Putnam Problems Book. It is about the Anning-Erdös theorem, which says that, if all the distances between pairs of points of an infinite set in the plane are integers, then the set is a subset of a straight line. When the review copy of the paper (*Bulletin AMS*, 51, 1945, 598-600) reached *Mathematical Reviews*, the Executive Editor, Ralph Boas, asked Irving Kaplansky to review it. Kaplansky discovered the now known simple proof. At that time Erdös was travelling and could not be reached. So Kaplansky published his proof under Erdös's name - it appeared in the same volume of the *AMS Bulletin* - on the theory that Erdös ought to have found it. Boas held the review till the paper of Anning-Erdös came out, reviewed it himself, and signed Kaplansky's name, just to symmetrize things. The proof is so short that it could be reproduced in the review (MR 7, p.164).

Paul Erdös believed in 'The Book' in which God maintains the perfect proofs of mathematical theorems, following the dictum of G. H. Hardy that there is no permanent place for ugly mathematics. Martin Aigner and Günter M. Ziegler have collected some new and brilliant proofs of classical results in their *Proofs from 'The Book'*. A good example of an elegant proof is L. M. Kelly's solution of Sylvester's problem: prove that if *n* points in the plane are not on one straight line, then there exists a straight line containing exactly two of the points. Kelly's proof, which is like a classic story, is included in *Proofs from 'The Book'*.

In recent years a new style of proof has emerged, especially in geometry and the theory of series and special functions. These proofs use an algorithm - usually executed on a computer - to convert a human-comprehensible problem into an enormous computation that can be carried out, always on a computer, and whose result, if it has the correct value, proves the original theorem. The seriously interested reader should read the book *A=B* by Marco Petkovsek, Herbert S. Wilf, and Doron Zeilberger (available on the Web, or, nicely printed and bound, from A K Peters); the idly curious may contemplate the idea of proving that two quadratic functions are equal by computing and comparing their values at three points. In geometry the results obtained have often been already known or too rococo to be of great interest; results on series and functions have been much more worthwhile, reminiscent of the work of Ramanujan.

It may be argued that such proofs have zero elegance of their own, though collectively they certainly have a share in some sort of postmodern aesthetic. In many cases the elegance of the statement of the theorem is enough to justify the proof, in much the same way that the elegance of many of Ramanujan's formulae caught mathematicians' imagination in the absence of proofs. But elegant and concise theorems are not obsolete just because they are not available in every case. "The Book" will live on, and sometimes a result first proved by computer will turn out to have a proof there as well.

NOTES DE LA SMC

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RÉDACTEURS EN CHEF
Robert J. MacG. Dawson; S.Swaminathan
notes-redacteurs@smc.math.ca

RÉDACTEURS-GÉRANT
Graham P. Wright
gpwright@smc.math.ca

RÉDACTION
Éducation : Edward Barbeau
notes-education@smc.math.ca
Réunions : Gertrud Jeewanjee
notes-reunions@smc.math.ca
Critiques littéraires: Peter Fillmore
notes-redacteurs@smc.math.ca
Recherche : Vacant
notes-recherche@smc.math.ca
Assistante à la rédaction :
Susan Latreille

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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EDITORS-IN-CHIEF
Robert Dawson, Srinivasa Swaminathan
notes-editors@cms.math.ca

MANAGING EDITOR
Graham P. Wright
gpwright@cms.math.ca

CONTRIBUTING EDITORS
Education: Edward Barbeau
notes-education@cms.math.ca
Book Reviews: Peter Fillmore
notes-reviews@cms.math.ca
Meetings: Gertrud Jeewanjee
notes-reunions@cms.math.ca
Research: Vacant
notes-research@cms.math.ca
Editorial Assistant:
Susan Latreille

The Editors welcome articles, letters and announcements, which can be sent to the CMS Notes at the address below.

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Canadian Mathematical Society - Société mathématique du Canada
577 King Edward, Ottawa, Ontario, Canada K1N 6N5
T: (613) 562-5702 F: (613) 565-1539
notes-articles@smc.math.ca
www.smc.math.ca www.cms.math.ca

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par S. Swaminathan
Université Dalhousie, Halifax

RUMINATIONS SUR LA PREUVE

Lors de la réunion de décembre 2006 à Toronto, la conférence la plus appréciée a été celle de V. Kumar Murty qui a parlé de la nature de la « preuve ». Cette allocution des plus intéressantes a alimenté de nombreuses conversations amicales entre membres. Une dame non-mathématicienne a exprimé son appréciation de la conférence en nous demandant pourquoi Fermat n'avait pas couché sur papier la mystérieuse preuve de son fameux problème. Nous lui avons expliqué que, comme les mathématiques étaient surtout un passe-temps pour Fermat, ses écrits se résumaient à des lettres envoyées à d'autres mathématiciens sur des problèmes qui l'intéressaient particulièrement. J'ai suggéré à la de lire à ce propos Le dernier théorème de Fermat, un livre de Simon Singh qui traite justement de ces questions.

La conversation a ensuite porté sur la longueur des preuves. On voulait, par exemple, savoir si celle donnée par Andrew Wiles à l'énigme de Fermat était la plus longue? Or, s'il est vrai que les deux articles parus dans la revue *Annals of Mathematics* qui présentent cette preuve comptent pas moins de 130 pages au total, c'est tout probablement la démonstration de la deuxième conjecture de Burnside sur la solvabilité de groupes d'ordre impair qui remporte la palme. Comptant 254 pages, elle remplit tout numéro du *Pacific Journal of Mathematics* de 1963. Et la preuve la plus courte? Alors là, certaines se résument à une seule phrase. D. Zagier, entre autres, a soumis une démonstration d'une seule phrase à la proposition que chaque nombre premier p congruent à 1(mod 4) est la somme de deux carrés. On trouvera cette démonstration dans l'*American Mathematical Monthly* (no 97, 1990, p. 144). Il existe aussi des versions simplifiées de preuves compliquées. Ainsi, la première preuve de Gauss de la loi de réciprocité quadratique n'est vraiment pas facile à comprendre. Ezra Brown en a proposé une version plus moderne dans l'*American Mathematical Monthly* (no 88, 1981, p. 257-264).

Irving Kaplansky a le tour des démonstrations simples. Dans le Problème de ménages, il faut déterminer combien de façons l'on peut faire asseoir n époux et n épouses autour d'une table, en alternant hommes et femmes de manière à ce que personne ne soit assis à côté de son conjoint ou de sa conjointe. De nombreuses études ont été consacrées à ce problème. Or, Kaplansky a publié une solution toute simple qui s'appuie sur deux lemmes (qui eux-mêmes sont fort intéressants) sur les diverses permutations et combinaisons possibles (*Bulletin of the AMS*, no 49, 1943, p. 784-785)

P. R. Halmos rapporte l'anecdote suivante dans sa critique (*American Mathematical Monthly*, no 88, 1981, p. 451) d'un livre de la série sur les problèmes du concours William Lowell Putnam. C'est à propos du théorème d'Anning-Erdös qui dit que, quand toutes les distances entre des pairs de points d'un ensemble infini sur un plan sont des entiers, cet ensemble est un sous-ensemble d'une ligne droite. Or, quand la revue *Mathematical Reviews* a reçu un exemplaire de presse de l'article d'Anning-Erdös (*Bulletin AMS*, no 51, 1945, p. 598-600), Ralph Boas, son directeur de la rédaction, a demandé à Irving Kaplansky de le réviser. Kaplansky s'est exécuté et a découvert la simple preuve que l'on connaît aujourd'hui. Or, Erdös était alors en voyage et ne pouvait être joint. Kaplansky a donc publié sa preuve dans le même volume du *bulletin de l'AMS* en l'attribuant à Erdös parce qu'il estimait que celui-ci aurait dû la trouver. Boas a attendu que paraisse l'article d'Anning-Erdös, puis il a publié la preuve sous le nom de Kaplansky par souci d'équité. Il s'agit d'une preuve si brève qu'elle figure dans le corps même du texte de Kaplansky (*Mathematical Reviews*, no 7, p. 164).

Suivant la maxime de G. H. Hardy voulant que les mathématiques disgracieuses n'ont pas de permanence, Paul Erdös se référait souvent à ce qu'il appelait « Le Livre » et dans lequel, disait-il, Dieu consigne les démonstrations parfaites des théorèmes mathématiques. Martin Aigner et Günter M. Ziegler ont répertorié plusieurs nouvelles et brillantes preuves de problèmes classiques dans leur livre *Proofs from 'The Book'*. Une démonstration particulièrement élégante est la solution proposée par L. M. Kelly au problème de Sylvester. Il s'agissait de montrer que si n points d'un plan ne sont pas colinéaires, il existe alors au moins une ligne droite qui contient exactement deux points. On peut consulter la démonstration de Kelly, qui se lit comme un récit classique, dans *Proofs from 'The Book'*.

Au cours des dernières années, un nouveau genre de preuve est apparu, notamment en géométrie et en théorie des séries et des fonctions spéciales. Il s'agit de démonstrations à base d'un algorithme – exécuté habituellement par un ordinateur – qui convertit un problème dont la représentation est humainement intelligible en un gigantesque calcul dont le résultat, s'il n'y a pas d'erreurs dans les valeurs utilisées, démontre la véracité du théorème original. Les lecteurs intéressés devraient lire à ce propos *A=B* de Marko Petkovsek, d'Herbert Wilf et de Doron Zeilberger. (L'ouvrage peut être téléchargé du Web. On peut aussi en commander un exemplaire imprimé et relié de l'éditeur A K Peters.) En géométrie, les résultats obtenus sont souvent déjà connus ou trop baroques pour être d'intérêt. Mais, ceux pour les séries et les fonctions en valent la peine et nous rappellent les travaux de Ramanujan.

S'il est vrai que de telles démonstrations n'ont aucune élégance en soi, il faut néanmoins avouer qu'elles possèdent collectivement une certaine beauté postmoderne. Souvent, l'élégance de l'énoncé du théorème suffit comme justification, de la même manière que la beauté des formules de Ramanujan séduit l'imagination des mathématiciens, même dans l'absence de preuves. En effet, malgré qu'il ne soit pas toujours possible de produire des théorèmes élégants et concis, cela ne les rend pas obsolètes pour autant. « Le Livre » d'Erdös continuera d'inspirer les mathématiciens et parfois le résultat, d'abord obtenu sur l'ordinateur, les mettra sur la piste du raisonnement divin.

A Complete State-of-the-Art Discussion

Aris Daniilidis, *Universitat Autonoma de Barcelona*

Duality for Nonconvex Approximation and Optimization

by Ivan Singer
CMS Books in Mathematics 24
Springer 2006 xviii +355pp

Roughly speaking, the word *approximation* refers to an inexact representation of an object (number, function, set ...) by objects of similar nature belonging to a predetermined class (for example, integer or rational numbers, smooth functions, convex sets...) which presumably enjoys better properties for our purposes. This simple idea is in fact the driving force in most proofs of analytic nature: in several occasions one might need to approximate a real number by a rational number, a continuous function by a polynomial, a real-analytic function by a jet, a non-linear differential equation by a linear one... In all the above cases, approximation theory will measure how good this representation is, estimating the errors introduced with this operation.

Although approximation theory developed independently, it finally became part of *optimization* theory, since, in most cases, one seeks to minimize (best approximation) or maximize (worst approximation) the distance of some point (initial object) to a given set (predetermined class of objects) in a certain metric space. Since then several textbooks have appeared, studying together the theories of approximation and optimization and their interactions. The current book *Duality for nonconvex approximation and optimization* (Springer 2006) by Ivan Singer makes its entrance as part of this general literature, focusing, as the title suggests, on a rigorous uniform presentation of both theories from the point of view of duality.

Let us explain in simple words this idea of duality. Generally speaking, the term *duality* refers to the study of minimization and/or maximization problems on a given space (often called primal space) with the aid of the elements of its conjugate space (whatever this means). The objective is to replace an initial (presumably difficult) problem with an equivalent (simpler) dual one, hopefully easier to be solved, since specific features of the problem are eventually explored. It is a classical and powerful tool in both theoretical and numerical optimization, particularly efficient in the convex case.

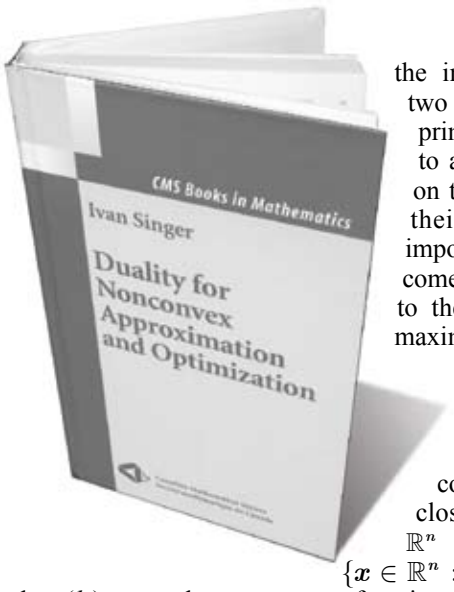
Let us further illustrate the above discussion with some examples. If f is a proper lower semicontinuous convex function defined on a Banach space X, then the conjugate function f^* of f is also a convex function on the dual space X^* defined by the formula

$$f^*(p) = \sup_{x \in X}\{\langle p, x\rangle - f(x)\}.$$

Considering again the conjugate f^{**} of f^* we obtain a convex function on X^* whose restriction to X recovers the initial function (cf. Fenchel duality). The famous Fenchel-Rockafellar theorem reveals one of the reasons for the whole operation. This theorem asserts that

$$\inf_{x \in X}\{f(x) + g(x)) = \max_{p \in X^*}\{-f^*(-p) - g^*(p)\}$$

whenever f, g are lower semicontinuous convex functions, finite at some $x_0 \in X$ which is moreover assumed to be a point of continuity of at least one of them. In other words, the problem of finding



the infimum of the sum of two convex functions on the primal space is equivalent to a maximization problem on the dual space involving their conjugates. An important advantage appears comes up: in strong contrast to the original problem, the maximum in the dual problem is always attained.

The problem of minimization of a convex function f over a closed convex subset of $\mathbb{R}^n$ of the form the $\{x \in \mathbb{R}^n : h_i(x) \le 0, i = 1,...,k\}$ the (h_i) are also convex functions here, gives room for another instructive example of duality. In this case the adopted method — called Lagrange duality — consists in considering the intermediate (Lagrange) function:

$$L(x,\lambda) := f(x) + \sum_{i=1}^{k} \lambda_i h_i(x), \quad (x,\lambda) \in \mathbb{R}^n \times \mathbb{R}^k_+,$$

and using it to build the (dual) concave function $\theta(\lambda) = \inf\{L(x,\lambda) : x \in \mathbb{R}^n\}$. It turns out that the initial minimization problem is equivalent to the following maximization problem of the concave function θ

$$\inf_{h_i(x) \le 0} f(x) = \sup_{\lambda \in \mathbb{R}^k_+} \theta(\lambda) = \sup_{\lambda \in \mathbb{R}^k_+} \inf_{x \in \mathbb{R}^n} L(x,\lambda).$$

The book of Ivan Singer succeeds perfectly in presenting together the theories of approximation and optimization through a formalized duality viewpoint, starting from the classical schemes (such as the ones mentioned above) and ending up with an abstract framework that goes far beyond convexity. The book starts with an extended preliminary session (Chapter 1), where elements of convex and quasiconvex analysis and classical dualities are recalled. The author introduces the terminology *reduction principle* to refer to the reduction of the computation of the distance from a convex set to a computation of the distance from a hyperplane. This simple idea motivates several of the results in the sequel. The main concepts of Lagrange duality (constraints being replaced by a penalization) and surrogate duality (replacing the constraint set by a family of surrogate constraint sets) for convex and quasiconvex minimization are introduced and analyzed. The author rapidly adopts a rigorous algebra-formalized approach and moves progressively to generalized dualities based upon generalized conjugacies, meaning that the duality mapping (inner product, in the case of Hilbert space) between a linear space X and its conjugate space X^* is now replaced by a so-called coupling mapping $c : X \times Y \to \mathbb{R}$. In Chapter 2 the author deals with the problem of the existence of furthest point (worst approximation) seeing as dual solutions of the corresponding deviation function. Chapters 3 and 4 are devoted to dualities adapted for the quasiconvex maximization problem, while Chapter 5 deals with the problem of finding the distance to the complement of a convex set. Chapters 6 and 7 refer to reverse convex minimization problems (dualities and optimal solutions), which belong to the general category of the so-called anti-convex systems. Chapter

8 is devoted to dualities for the important class of DC functions (difference of two convex functions). Finally, in Chapter 9, the presentation rejoins the framework of Abstract Convexity (already briefly mentioned in the first chapter), introducing a very general setting encompassing various generalizations of convex sets and functions. The book concludes with historical and bibliographical comments (Chapter 10), an extended literature and a useful subject index of both formulas and terms.

Overall, *Duality for nonconvex approximation and optimization* is a self-contained book on nonconvex dualities, the first monograph on this topic. It combines classical and new material and is written with a clear care to avoid ambiguities and eliminate doubts. There are explanations of everything with all possible details, which sometimes are more than enough. This extreme precision in both formulas and explanatory text eventually becomes difficult to absorb. On the other hand, the manuscript is remarkably typo-free, keeps prerequisites in a minimal level, and can be read by non-specialists from the very beginning till the end. The spirit of the textbook is reminiscent of abstract convex analysis. This latter field has recently reached its maturity, partially also due to contributions of the author who has long been one of its leading experts. On various occasions the employed techniques are pure algebraic formalism rather than classical analysis; however, in counterpart, it is noteworthy that elegant schemes of convex duality arise naturally (and sometimes unexpectedly) in several nonconvex situations.

As a conclusion, duality theory contributes to optimization and approximation in both theoretical and practical aspects, although computational aspects are not present in this book. Instead, the author provides a complete state-of-the-art discussion and helpful suggestions. Let us hope some of the readers will be inspired to implement some of these nonconvex dualities to solve numerical problems in an efficient way.

PROBLEM OF THE MONTH

The following problem was submitted by Dr. Robert Dawson of St. Mary's University.

The Ultimate Four 4's

An old problem asks the solver to give expressions, using four 4's (which may be used as digits or on theor own) and standard mathematical operations, for as many natural numbers as possible. If the operations are restricted to addition, subtraction, multiplication, and division, the set of reachable numbers is large but not huge. Allowing other standard functions such as roots, logarithms, etc. allows us to go somewhat further, with expressions such as $121 = \left(\frac{44}{4}\right)^{\sqrt{4}}$.

Just which natural numbers can we obtain?

Send your own favorite problems to: notes-editors@cms.math.ca

Solution for March's problem: page 10

WANTED: Books for Review
RECHERCHÉS : Livres pour critiques littéraires

Have you written a book lately?
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.

Vous avez récemment écrit un livre? 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.

Peter Fillmore
Department of Mathematics and Statistics
Dalhousie University
Halifax NS B3H 3J5

A Vibrant Area of Modern Mathematics

Henri Darmon, *McGill University*

Lectures on Automorphic L-Functions

by James Cogdell, Henry Kim and Ram Murty
Fields Institute Monographs 20
AMS 2004 xii + 283 pages

The Langlands Functoriality Conjecture is the number theorist's "grand unified theory". It describes and elucidates the platonic realm of modular forms, L-functions, and motives — a world arguably no less real, in its richness, than the physicist's universe of elusive particles and far-flung galaxies.

The timely volume under review (referred to henceforth as CKM) is made up of three distinct contributions of about 100 pages each:

[C] A survey of L-functions of automorphic forms and converse theorems for GL_n, written by James Cogdell;

[K] An account by Henry Kim of his recent work with Shahidi on certain special cases of functoriality (which will be described more precisely below);

[M] Ram Murty's exposition of some of the applications of these results and of related conjectures to classical questions in analytic number theory.

All three contributions are motivated by the striking work of Kim and Shahidi on functoriality for the symmetric third [KS] and fourth [Kim] powers of the standard representation of $GL(2)$. Thus CKM makes an ideal introduction to the main techniques—most crucially, the converse theorems of Cogdell and Piatetski-Shapiro, and the Langlands-Shahidi method—that were instrumental in obtaining these results. Because CKM is resolutely pitched at the motivated graduate student or the expert in automorphic forms, it is a challenge to convey its contents to a broader readership, reconciling the sometimes competing demands of simplicity and precision. We will sacrifice a bit of the latter to the former, and focus on one of the many threads that runs through the volume: functoriality for symmetric powers and its relation to the Sato-Tate conjecture, a topic of much current interest in light of the recent breakthroughs of [CHT], [HSBT], and [Ta].

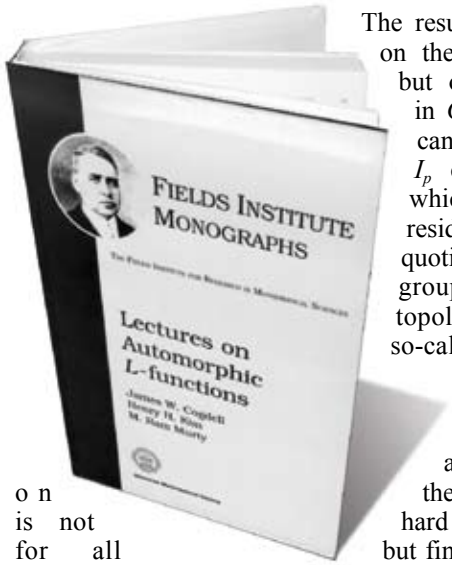
To an elliptic curve E over $\mathbb{Q}$ is associated a collection of *Galois representations* (parametrised by positive integers n)

$$\rho_{E,n} : \mathrm{Gal}(\bar{\mathbb{Q}}/\mathbb{Q}) \to \mathrm{Aut}(E[n]) \simeq \mathrm{GL}_2(\mathbb{Z}/n\mathbb{Z}),$$

obtained by considering the action of the absolute Galois group of $\mathbb{Q}$, denoted $G_{\mathbb{Q}} := \mathrm{Gal}(\bar{\mathbb{Q}}/\mathbb{Q})$, on the n-division points of the divisible group $E(\bar{\mathbb{Q}})$, (a group which is abstractly isomorphic to $(\mathbb{Z}/n\mathbb{Z})^2$). Packaging these representations together as n ranges over the powers of a prime ℓ leads to the fundamental ℓ-adic representation

$$\rho_E : G_{\mathbb{Q}} \longrightarrow GL_2(\mathbb{Z}_\ell) \tag{1}$$

Understanding such naturally occurring representations of $G_{\mathbb{Q}}$ is one of the central questions in number theory. To be more precise about what is meant here by "understanding," we note that the group $G_{\mathbb{Q}}$ carries a plethora of extra structures, most notably a collection of so-called *decomposition subgroups* $G_p : \mathrm{Gal}(\bar{\mathbb{Q}}_p/\mathbb{Q}_p)$ indexed by the rational primes p and arising from the various p-adic completions of $\mathbb{Q}$. The inclusion of G_p in $G_{\mathbb{Q}}$ is obtained by choosing an embedding of the algebraic closure $\bar{\mathbb{Q}}$ into $\bar{\mathbb{Q}}_p$ and associating to $\sigma \in G_p$ its restriction to $\bar{\mathbb{Q}}$.



The resulting inclusion depends on the choice of embedding, but only up to conjugation in $G_{\mathbb{Q}}$. The group G_p has a canonical normal subgroup I_p consisting of elements which act trivially on the residue field of $\bar{\mathbb{Q}}_p$, and the quotient G_p/I_p is a procyclic group with a canonical topological generator, the so-called *Frobenius element* Frob_p. (It is defined by the condition that it induces the automorphism $x \mapsto x^p$ on the residue field at p.) It is not hard to show that $\rho_E(I_p) = 1$ for all but finitely many p. When this condition is satisfied, one says that ρ_E is *unramified at p*. For such primes, the image $\sigma_p := \rho_E(\mathrm{Frob}_p)$ of Frob_p is a well-defined element of $GL_2(\mathbb{Q}_\ell)$ - or, more precisely, a canonical *conjugacy class* (because G_p is only well-defined up to conjugation in $G_{\mathbb{Q}}$). Understanding the behaviour of the classes σ_p as p varies is an important theme in the branch of number theory devoted to *generalised reciprocity laws*. Questions of this type can be traced back to the fundamental law of quadratic reciprocity proved by Gauss. The connection with quadratic reciprocity is that, in the simpler case where

$$\rho : G_{\mathbb{Q}} \longrightarrow \pm 1 \tag{2}$$

is a (continuous) one-dimensional representation of order 2, and K is the quadratic field of discriminant D determined by ρ (i.e., the fixed field of its kernel), it follows directly from the definition of Frobenius elements that σ_p is 1 or -1 depending on whether D is a square or a non-square modulo p. That this latter condition depends only on the value of p modulo $4D$ is the content of the law of quadratic reciprocity. The periodicity of σ_p for the representation ρ of (2) reveals an a priori unexpected *regularity* of the function $p \longrightarrow \sigma_p$, and it is this type of pattern one would like to unveil for more complicated sequences of frobenius elements such as those arising from the Galois representation of (1).

Returning to the case of (1), basic facts in the theory of elliptic curves show that the characteristic polynomial of σ_p is of the form

$$x^2 - a_p x + p = (x - \alpha_p)(x - \beta_p),$$

where a_p is an *integer* (which in fact is independent of the choice of $\ell \neq p$) satifying $|a_p| < 2\sqrt{p}$, so that the complex roots α_p and β_p lie on the circle of radius $\sqrt{p}$. The *Hasse-Weil* L-*series*, defined by the infinite product (taken over the primes p for which ρ_E is unramified)

$$L(E,s) := \prod_p (1 - x_p p^{-s})^{-1}(1 - \beta_p p^{-s})^{-1} =: \sum_{n \geq 1} a_n n^{-s},$$

packages the data from the σ_p into an *Euler product* which converges in the right half-plane of $s \in \mathbb{C}$ with $\mathrm{Real}(s) > 3/2$. (This convergence is a direct consequence of the inequality $|a_p| < 2\sqrt{p}$,

continued page 26

La Fouly, 2nd edition

by Silviu Guiasu
Advanced Knowledge International, Adelaide
2006 353 pages AU $44

This charming book, aptly subtitled *Chatting About Mathematics and Life in a Remote Swiss Alpine Village*, is directed in particular to undergraduates who are considering further studies in mathematics, and more generally to anyone fascinated by the subject and wanting to know more about it. Although written in the form of a novel, it contains a tremendous amount of information about mathematics, mathematicians, and their profession, all recounted in an accurate but approachable way.

The main characters are Mike, a young Canadian student, and John, a senior math professor at the University of Manchester. They meet while on vacation in Switzerland and spend six days together exploring the hiking trails around La Fouly. When Mike learns that he's in the company of a mathematician, the questions begin and we find ourselves immersed in discussions ranging from logic and set theory to game theory, and from Newton to Grothendieck and Erdös. Along the way we encounter philosophical musings on teaching, the will, and life in general. The subject matter is interlaced with descriptions of their hikes and meals together, even including a little love interest in the form of a Dutch girl, Francine, who worries about Mike when a storm delays his return from a hike. And yes, Mike does decide to go on in mathematics.

There are some typos and quite a bit of nonstandard English, but the meaning is never in doubt. Buy this book for a young friend who wonders what your job is all about! It can be ordered at innoknowledge.com.

Elements of Real Analysis

by M.A. Al-Gawaiz and S.A. Elsanousi
Chapman & Hall/CRC 2006 436 pp $89.95 US

This book is based on lecture notes used, over the past fifteen years, for a course given by the authors to third- and fourth-year mathematics students at King Saud University, Riyadh. After a preliminary chapter on sets, relations and functions, there are chapters dealing with real numbers, sequences, series, the limit of a function, continuity, differentiation, the Riemann integral, sequences and series of functions, and Lebesgue measure and integration. The chapters are divided into sections, each including a set of up to a dozen exercises. The usual definition-theorem-proof format is followed. The book concludes with a page of references, a list of notations, and a four-page index. The presentation is clear and pleasant, but the authors do not claim any particular novelty for it.

The Best of All Possible Worlds: Mathematics and Destiny

by Ivar Ekeland
Chicago 2006 207 pp hb $25 US

A Professor of Mathematics and Economics at UBC and Director of PIMS, Ivar Ekeland is well-known for his skill and success as a popularizer of mathematics. This book, originally published in French in 2000, will only add to these laurels.

The idea of *The Best of all Possible Worlds* goes back at least as far as Voltaire, who used it in Candide to lampoon certain ideas of Maupertuis. This French polymath enunciated a principle of least action and, having asserted that the laws of physics follow mathematically from it, went on to claim that similar principles govern all life. Thus, for example, human interaction would be such as to minimize total suffering. Ekeland uses the phrase as a motto for this engrossing study of the development of optimization and its applications. The first two chapters discuss the emergence of the ideas of modern science, from Galileo, who "discovered the mathematics of time, just as the ancient Greeks discovered the mathematics of space", to the analytic geometry of Descartes, to the clockwork universe of Newton and Leibniz's attempts to understand the role of God in such a universe.

With this background in place, we come to the "principle of least action", as illustrated in the work of Descartes, Maupertuis, Fermat and Euler on the underpinnings of the well-known laws of reflection and refraction. This leads, in Chapter 4, to a discussion of integrable and nonintegrable systems, again illustrated by an extensive discussion of a concrete example: the motion of a ball on a billiard table. Here the reader is introduced to the notions of chaos and stability. Next comes the "stationary action principle", which is demonstrated in action by finding the periodic motions of a billiard ball.

Ekeland's summary of the book so far is: "We have found randomness at the subatomic scale and chaos at our own scale, with the stationary action principle caught somewhere in between." The remaining chapters are devoted to following the idea of optimization as it moves "from physics into biology, and then into the social sciences".

Any reader will learn a great deal from this book, and find a great deal to ponder. Unfortunately it is marred by poor editing--typos and errors in translation are frequent. Most of this is merely annoying, but in a few cases it significantly hampers understanding.

Textbooks: Conceptions and Misconceptions

Ann Kajander *(Lakehead University)*
and Miroslav Lovric *(McMaster University)*

Rightly or wrongly, textbooks continue to fundamentally influence classroom practice. Students use mathematics textbooks to study and to do homework questions, while professors and teachers may use them to prepare classes and to teach, as well as to look up a formula or a theorem, and even to prepare tests for students. Texts have the potential to influence both the material to be covered and the way in which it is presented. "The dominance of the textbook is illustrated by the finding that more than 95% of 12th grade teachers indicated that the textbook was their most commonly used resource." (McKnight *et al.*, 1987). However, while textbooks affect our thinking about teaching, we rarely think about studying the textbooks themselves.

Some effort has been put into content analysis and exploring the ways in which textbooks are used in classrooms and beyond (for example, Love & Pimm, 1996; McRory, 2006). However, very few mathematics education researchers have taken a really close look at what is in the textbooks, with the focus on how the material is presented and what kind of learning may be implied. Market research, rather than research based on mathematics education sources, is usually used to determine content and approach (Clements, 2007).

An initiative of the American Association for the Advancement of Science, Project 2061 is a long-term project aimed at evaluating teaching and learning resources in science and mathematics. According to one of their studies, "the majority of textbooks used for algebra have some potential to help students learn, but they also have serious weaknesses" (Project 2061, 2000). More than half of the twelve textbooks evaluated were considered adequate, but none was rated highly. Three textbooks that have been widely used were rated "so inadequate that they lack potential for student learning" (Project 2061, 2000). Project 2061 used the guidelines of the National Council of Teachers of Mathematics (NCTM) (referred to as the *Standards* for how and what students should learn.) According to the Project 2061 findings, authors of textbooks generally ignore the research on how students acquire ideas and concepts.

Our work is grounded in the theory of conceptual change (Davis, 2001; Biza *et al.*, 2005) which provides a framework for the study of potential student misconceptions related to learning from textbooks. The theory describes learning processes of adults as well as children and hence is appropriate in addressing high school as well as university students.

Based on a certain amount of information (learned from a book or presented by a teacher, for example), a student (learner) uses her/his own ideas and current understanding to create an initial explanatory framework. Their current beliefs about the material are formed by the presuppositions that inhabit this initial framework, also known as naïve beliefs or alternative conceptions. When attempting to absorb material that is in some way incompatible with prior knowledge, the student will try to assimilate new information into their existing framework, thus creating a so-called synthetic model. As a mixture of beliefs and scientific facts, this synthetic model represents the student's misconceptions about the subject. Evidence suggests (Davis, 2001; Biza *et al.*, 2005) that such formed beliefs are very strong and, consequently, synthetic models can become quite robust in one's cognitive environment. It is an important purpose of a course instructor to identify these models and to apply adequate means in teaching and learning environments to overcome them. Textbooks may play an important role in such development.

We have begun to take a closer look at textbooks commonly used in Ontario at the secondary and first year university levels, to determine to what extent, and how, mathematics textbooks potentially contribute to the creation and strengthening of students' conceptions and misconceptions about mathematics. More generally, we are investigating to what extent textbooks might promote (or not) deep, conceptual understanding of the material that they present. Assuming that a teacher or instructor will teach with the textbook, this kind of research raises awareness of a variety of problems and issues students face when they learn mathematics from written sources. It could inform the instructor of a variety of situations that need to be addressed in their classes.

We provide an example to illustrate the issue under consideration. Consider the concept of the tangent line to the graph of a function $y = f(x)$. A common synthetic model many entering first-year university students possess includes statements such as 'the tangent is the line that touches a graph of $y = f(x)$ at only one point,' or 'a tangent cannot cross the graph of $y = f(x)$.' We began exploring how such conceptions might arise. When we examined a grade 12 calculus textbook currently in use in some Ontario schools, we found evidence that could support (or at best fail to correct and clarify) such a misconception. For example, in one source, while the initial explanation near the beginning of the chapter on tangents states (with accompanying diagrams),

> In the graphs of the circle and the parabola, a tangent line touches exactly one point of the graph P. For other curves, such as the one in the third diagram [an example of a tangent line that also crosses the curve at two other points] a tangent line touches the graph at the point of tangency, P, but may pass through other points on the graph as well. (Kirkpatrick *et al.*, 2002, 183)

but, later on a summary box highlighted in blue contains the unadorned statement defining a tangent as follows:

> A tangent is a line that touches exactly one point on the graph of a relation. (Kirkpatrick *et al.*, 2002, 190)

The highlighting of the foregoing statement in a coloured summary box may increase the likelihood of it being the definition focussed on predominantly by the student.

Certain misconceptions arise from correct statements, when one forgets the precise (narrow) context in which they originally appeared. Some high school texts contain the statement that a tangent line to a circle is a line that intersects the circle in exactly one point (and the circle lies entirely in one of the two half-planes defined by the line), This statement, of course, no longer holds when one considers the graphs of certain functions.

Similarly, standard university calculus texts contain numerous illustrations of tangent lines. However, in a majority of cases, the tangent is shown in the 'generic' position where it 'touches' the curve at one point (and does not cross it). The concept of

'touching' is further suggested in examples where students are given the graph of a function $f(x)$ and are asked to sketch the graph of its derivative $f'(x)$. Although the tangent is defined as the limit of secant lines, these examples do not attempt to encourage drawing the tangent or thinking about it (either in illustration or in accompanying text) as limiting position of secant lines.

To address this potential misconception, a textbook (or instructor) could ask students to create illustrations that show relationships between curves and lines and identify which are (or are not) tangents (Lovric, 2007). These illustrations should include cases such as (a) a tangent that does not `touch' on one side of the curve, but instead crosses the curve at the point of tangency, (b) a tangent that crosses the graph at two (or more) points (one of which is the point of tangency), (c) a tangent line that `touches' the graph at more than one point, (d) a line that `touches' the graph, does not cross it, but is not a tangent (cusp), *etc*... By analyzing such situations, students could potentially rework some of their misconceptions and expand their cognitive model of the tangent.

Although the approach just outlined has potential benefits and might build on the intuition, it does not go far enough. As an alternative model, visualize the tangent definition (*i.e.* the limit of secant lines) a sequence of magnifications, zooming in on the point of tangency (for example, see Alexander *et al.*, 2003, 21). Some textbooks do show this, but do not emphasize strongly enough its importance. If these magnifications tend to flatten the graph (*i.e.*, make it look more and more like a line), then the graph (most likely) has a tangent line at the point in question.

The "zoom" feature of the graphing calculator, a tool that is readily available in most high school classrooms, might easily support the development of an effective dynamic model of the tangent as just described. The fact that the "magnification" cognitive model of the tangent is fundamentally different from the usual 'tangent touches the curve' model could potentially prevent the student from building a synthetic model of the tangent (*i.e.*, it becomes difficult to assimilate the notion of 'zooming in' with the notion of 'touching'), Instead, it might force the student to completely abandon the presuppositions of the 'tangent touches the curve' model and adopt the new 'magnification' model. Furthermore, the 'magnification' model naturally leads into the discussion of the role of tangent as the best approximation of the graph of a function by a straight line.

In our forthcoming work, we plan to investigate further misconceptions related to tangents and derivatives (local linearity, linear approximation and differentiability), as well as those related to other concepts. We believe that, as students move through the revised secondary curriculum and (potentially) develop deeper and more accurate conceptual understandings of fundamental concepts, that more attention should be paid to textbooks to support rather than marginalize such growth. Rather than criticizing the predominant use of textbooks by teachers, better success might be achieved by ensuring the quality of these texts in promoting deep and accurate student understanding.

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Project 2061 (2000), *Algebra for all - not with today's textbooks, says AAAS*. Press release: `http://www.project2061.org/about/press/prooo426.htm`

Comments from the editor. The foregoing paper was based on a brief talk given by the authors at a meeting of the Mathematics Education Forum at the Fields Institute in January, 2007. They are preparing an extended version of this paper for an education journal.

It is interesting to contrast the role played by textbooks when I was an undergraduate to their role today. While a few of my courses had an assigned text, the text was loosely followed and the lecturer generally went pretty much his own way. Some lecturers might give a list of references for the course, which may or may not have a bearing on the material covered. Because of this loose attachment between course and text, students learned early not to rush out and buy the text, but to wait to see what the prevailing wisdom was from fellow students in the same or higher year. Indeed, on one occasion it was impossible to get the text. Donald Coxeter recommended a differential geometry by Erwin Kreyszig, published by the University of Toronto. Perhaps he had seen the manuscript, for investigation revealed that the text had not yet been published and indeed it did not appear for at least a year afterwards. The recommended text for a course on

complex variables was E.C. Titchmarsh's *Theory of Functions*, a book whose opacity for undergraduates has probably never been surpassed; the grapevine suggested that a little Oliver and Boyd book by Phillips on complex variables, costing about a dollar, was a better buy.

John Coleman, with a nod to the New Mathematics, recommended a first year calculus text by E.G. Begle, to which many students took an immediate antipathy. However, we became aware that the previously used text by Sherwood and Taylor was highly regarded by the students, and acquired second-hand copies. I found it a useful source of material when in the fullness of time, I taught calculus myself. Faced with such inconsistent material, students prowled the bookstore, where they discovered the Oliver and Boyd series of blue introductory books, each pocket-sized with about 60 pages chock full of nice examples and old Tripos questions, and the classics reprinted by Dover - all very easy on the wallet.

Of course, the situation has markedly changed since then, as, at least for the mathematics specialist, many fine books have come onto the market. But the questions still remains as to what the proper relation should be between textbook and course. With the support of a good textbook, the lecturer should be able to cast the burden of a full treatment and suitable examples and problems largely on the author, while she can select what she feels is particularly significant, weave the connecting tissue, and provide a kind of worldview of the subject. We, as lecturers, are *witnesses* to what we teach; our role is to help the student discover what is worth their time and attention, and to guide them in the optimal use of the resources around them, of which textbooks are but one part.

In this day of electronic resources, it is hard to see why it is necessary that students are burdened with such heavy tomes, particularly in their more elementary courses. Books should be slender *vade mecum*s, a repository of the essential results clearly presented with key examples and nice problems, and everything else should be available on the net or in libraries.

EJB

The CMS would like to thank the following individuals and departments for providing the required backissues of CJM.

La Société tient à remercier les personnes suivantes qui ont généreusement fait don de numéros antérieurs dans le cadre d'un projet comportant un tri destructif de numéros du Journal canadien de mathématiques et du Bulletin canadien de mathématiques.

Dr. David Pike	Memorial University of Newfoundland
Dr. Eddy Smet	University of Western Ontario
Dr. Karl Dilcher	Dalhousie University
Dr. Ben Gardner	Memorial University of Newfoundland
Dr. Bill Sands	University of Calgary
Dr. Daryl Tingley	University of New Brunswick-Fredericton
Dr. Michael Josephy	University of Costa Rica
Dr. Paul Binding	University of Calgary
Dr. Leslie Davison	Laurentian University
Dr. Adam Van Tuyl	Lakehead University, Department of Mathematics & Statistics

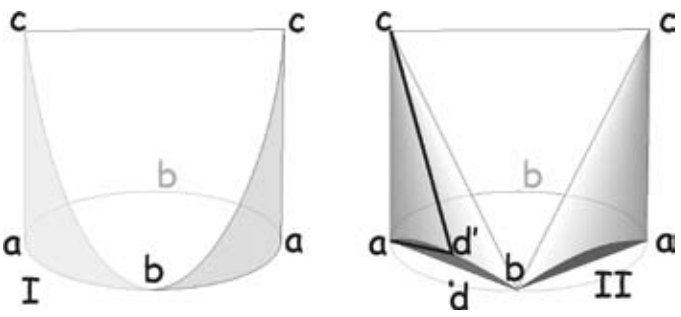
Solution to March's Problem

The maximum-volume solution is unique, and is obtained by making two planar cuts in a cylinder (Figure I). Its volume ($2\pi - 8/3 \approx 3.616$) can be found using calculus - or even without: see J.H. Butchart and L. Moser, "No Calculus, Please!", *Scripta Mathematica* **18** (1958).

To find the minimum-volume convex solution, we note that any solution must include the points *a*,*a*, the points *b*,*b*, and the top edge $\overline{cc}$. It must also contain a point d' above each point *d'* on the circle *abab*, giving a body like that shown in Figure II.

By integrating in cylindrical coordinates about the axes $\overline{ac}$, we see that the choice of the point *d* does not affect the volume, as the triangles Δ *acd'* and Δ *acd* have the same area. This volume is most conveniently computed when *d*=*d'*, and is found to be $2\pi/3 + 4/3 \approx 3.43$. The points *d'* must be carefully chosen - for instance, on a plane through $\overline{ab}$ - to ensure convexity.

The literature (for instance, Butchart and Moser, *op. cit*, and Gardner (*More Mathematical Puzzles and Diversions*, 1964 p. 40) cites a still smaller solution, whose sections perpendicular to $\overline{cc}$ are isosceles triangles with bases on the circle *abab*, and this solid has volume π (which can again be found without calculus as half the volume of the circumscribed cylinder.) However, this is not convex - as can indeed be seen from the illustration in Gardner's book - and nonconvex solutions may have arbitrarily small volume!



Call for Applications - CMS Executive Director and Secretary
Appel de candidatures - Directeur administratif et secrétaire de la SMC

The Canadian Mathematical Society (CMS), one of the leading mathematics organizations in Canada, seeks applications for the position of Executive Director and Secretary. This position offers a unique and exciting opportunity for an individual with energy, drive, initiative and enthusiasm to make a difference on the national stage.

The CMS works to enhance Canada's capacity to innovate and compete globally by promoting the discovery, learning and application of mathematics in Canada. With approximately 1000 members from across Canada and beyond, the CMS's active volunteers support efforts that identify and develop young mathematicians through its math competitions, math camps and other educational activities. The CMS enhances the practice of mathematics in Canada through national conferences, and by publishing research journals, books, and newsletters in both print and electronic formats.

The work of the CMS is carried out by a large number of dedicated and enthusiastic volunteers, together with a superb and experienced staff of eight at the Executive Office in Ottawa. The Executive Director and Secretary must be an effective and experienced administrator, able to address differing points of view with the tact and courtesy appropriate to a largely volunteer organization. The position is full-time and requires sound judgment, independence, travel, and flexibility in the scheduling of working hours.

The Executive Director and Secretary is appointed by the Board of Directors of the CMS, reports to the CMS President and represents the CMS to universities, governments, the corporate sector, institutes, and to other societies and officials. He/she is responsible to the Executive Committee and the Board of Directors of the CMS for the operations of the CMS Executive Office and for the other administrative offices throughout Canada. He/she works in close contact with the CMS President, with responsibility for aspects of the Society's publications, meetings, fundraising, web site, projects, and operations. Some restructuring of the current duties in the position is possible, to align them with the skills of an outstanding applicant. The position starts July 1, 2008 (but the ability to assume some duties on a part-time basis prior to that date is an asset).

QUALIFICATIONS

A doctoral degree in mathematics or experience in an academic and research environment in mathematics is preferred. The candidate should have: prior administrative or managerial experience; excellent organizational skills; excellent interpersonal skills; excellent analytical and problem solving skills; excellent and proven communication skills (preferably in both official languages); experience in setting and managing budgets; and the ability to develop and implement policies that support and promote the work and programs of the CMS. Experience in fundraising and promotion is an advantage. The candidate will work principally out of the CMS Ottawa office.

The deadline for applications is **April 30, 2007, 4pm**. Please submit applications, including a resume, cover letter, and the names of at least three references by fax, email or mail to:

La Société mathématique du Canada (SMC), l'un des principaux regroupements mathématiques du pays, cherche à pourvoir le poste de directeur administratif et secrétaire. C'est un poste unique et stimulant, idéal pour une personne énergique, dynamique, enthousiaste et ayant l'esprit d'initiative qui souhaite se distinguer sur la scène nationale.

La SMC a pour mission de rehausser la capacité du Canada d'innover et d'être concurrentiel à l'échelle mondiale en favorisant la découverte et l'apprentissage des mathématiques, et les applications qui en découlent, au Canada. Forte de ses quelque 1000 membres du Canada et d'ailleurs, et grâce au travail bénévole de nombreux membres actifs, la SMC dépiste et forme de jeunes mathématiciens par l'entremise de concours, de camps et d'autres activités mathématiques éducatives. La SMC rehausse l'activité mathématique au pays par l'organisation de congrès nationaux et la publication de revues, de livres et de bulletins, en format papier et électronique.

Les activités de la SMC sont menées par un grand nombre de bénévoles dévoués et enthousiastes, appuyés par un personnel hors pair et compétent de huit personnes au bureau administratif d'Ottawa. Le directeur administratif et secrétaire doit être une personne efficace et expérimentée, capable de gérer des points de vue divergents avec le doigté et la courtoisie nécessaire dans un organisme en grande partie bénévole. Le ou la titulaire de ce poste à plein temps doit posséder un bon jugement, être autonome, pouvoir se déplacer fréquemment et être souple quant à son horaire de travail.

Le directeur administratif et secrétaire est nommé par le conseil d'administration de la SMC, relève du président de la SMC et représente la SMC auprès des universités, des gouvernements, du secteur privé, des instituts et d'autres sociétés et dirigeants. Cette personne est redevable au comité exécutif et au conseil d'administration de la SMC pour ce qui est du fonctionnement du bureau administratif d'Ottawa et des autres bureaux de la SMC Canada. Elle travaille en étroite collaboration avec le président de la SMC, et s'occupe de divers aspects des publications, des congrès, des activités de financement, du site internet, des projets et du fonctionnement. Une certaine restructuration des tâches actuelles du titulaire du poste est possible, de manière à tenir compte des compétences d'un candidat ou d'une candidate remarquable. La personne choisie entrera en fonction le 1er juillet 2008 (la possibilité d'assumer certaines tâches à temps partiel avant cette date est toutefois un atout).

COMPÉTENCES

La préférence sera accordée à une personne qui possède un doctorat en mathématiques ou de l'expérience en milieu universitaire et en recherche dans le domaine des mathématiques. Cette personne possédera : de l'expérience en gestion; un sens aigu de l'organisation; un excellent sens des relations humaines; une excellente capacité d'analyse et de résolution de problèmes; des compétences linguistiques exceptionnelles et éprouvées (préférablement dans les deux langues officielles); de l'expérience en planification et en gestion budgétaire; des aptitudes pour l'élaboration et l'application de politiques qui soutiennent et stimulent les activités de la SMC. Une bonne connaissance des campagnes de financement et de promotion constituera un avantage. Le bureau administratif de la SMC à Ottawa est le lieu de travail principal.

Les personnes intéressées ont jusqu'au **30 avril 2007 à 16 h** pour poser leur candidature. Elles doivent faire parvenir leur demande, accompagnée d'un curriculum vitae, d'une lettre de présentation et d'au moins trois références, par fax, par courriel ou par la poste à :

Executive Director Search / Concours pour le poste de directeur administratif
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Ottawa, Ontario Canada K1N 6N5
Attn: Dr Thomas Salisbury, CMS President / président de la SMC
Tel: 613.562.5702 FAX: 613.565.1539
e-mail: president@cms.math.ca / courriel : president@smc.math.ca

April 13-14, 2007, "Young Mathematicians Conference IV", Fields Institute
www.fields.utoronto.ca/programs/scientific/06-07/young_math/

April 13-15, 2007, "Lie Algebras Workshop", University of Ottawa
www.fields.utoronto.ca/programs/scientific/06-07/liealgebra/

April 15-17, 2007, "Second Canadian Genetic Epidemiology & Statistical Genetics Meeting", Fields Institute
https://canadiangeneticepi.ccb.sickkids.ca/en/

April 27, 2007, "CRM-Fields-PIMS Prize Lecture", Joel Feldman, University of British Columbia
www.fields.utoronto.ca/programs/scientific/06-07/crm-fields-pims/feldman.html

April 28-30, 2007, "Workshop on Applications of Traces to Algebra, Analysis and Categorical Logic", University of Ottawa
http://aix1.uottawa.ca/%7Escpsg/Fields07/Fields07.traces.html

May 4-6, 2007, "Workshop on the Interaction between Probability and Functional Analysis", Carleton University
www.fields.utoronto.ca/programs/scientific/06-07/probabilityanalysis/

May 7-9, 2007, "Workshop on the Mathematics of Evolution: Adaptive Dynamics in Theory and Practice", University of Ottawa
www.mathstat.uottawa.ca/%7Efluts037/FIELDS/fieldsworkshop.html

May 8, 2007, Mathematics and Society: "The Nathan and Beatrice Keyfitz Lectures in Mathematics and the Social Sciences", Speaker: Joel Cohen, Professor of Populations, Rockefeller and Columbia Universities, New York
www.fields.utoronto.ca/programs/scientific/keyfitz_lectures/

May 11-12, 2007, "Workshop on Global Optimization: Methods and Applications", Fields Institute
www.fields.utoronto.ca/programs/scientific/06-07/globalopt/

May 25-26, 2007, "Ottawa-Carleton Discrete Mathematics Workshop", Carleton University
www.fields.utoronto.ca/programs/scientific/06-07/discrete_math/

May 28- June 1, 2007, "Seventh Canadian Summer School on Quantum Information", University of Waterloo
http://www.iqc.ca/quantumworld/index.php?id=2&pid=15

May 28-31, 2007, "Canadian Discrete and Algorithmic Mathematics Conference (CANADAM 2007)", Banff Conference Center, Alberta
http://www.cs.ualberta.ca/%7Emreza/CANADAM/

May 31-June 2, 2007, "Lattices and Trajectories: A Symposium of Mathematical Chemistry in honour of Ray Kapral and Stu Whittington", Fields Institute
www.fields.utoronto.ca/programs/scientific/06-07/lattices/

June 1-3, 2007, "16th International Workshop on Matrices and Statistics", University of Windsor
http://www.uwindsor.ca/iwms

June 5-8, 2007, "Probability and Stochastic Processes Symposium in Honour of Donald A. Dawson's work", Carleton University
www.fields.utoronto.ca/programs/scientific/06-07/stochastic/

June 5-9, 2007, "35th Canadian Operator Symposium(COSy)", University of Guelph
www.fields.utoronto.ca/programs/scientific/06-07/COSy/

June 18-23, 2007, "Conference on Combinatorics and Optimization", University of Waterloo
www.fields.utoronto.ca/programs/scientific/06-07/CO40/

June 27-29, 2007, "Randomization of Quantum Systems Workshop Institute for Quantum Computing", University of Waterloo
www.iqc.ca/quantumworld/index.php?id=4

July 7, 2007, "Future Directions of Computational and Mathematical Neuroscience", Fields Institute
www.fields.utoronto.ca/programs/scientific/07-08/neuroscience/

July 16 - 20, 2007, "Workshop on Noncommutative Dynamics and Applications", Fields Institute
www.fields.utoronto.ca/programs/scientific/07-08/operator_algebras/

July 18-21, 2007, "CUMC 2007 Canadian Undergraduate Mathematics Conference", Simon Fraser University
http://cumc.math.ca/2007/en/

July 25-28, 2007, "Symbolic-Numeric Computation (SNC'07) and Parallel Symbolic Computation '07 (PASCO '07)", University of Western Ontario
www.orcca.on.ca/conferences/pasco2007/site/
www.orcca.on.ca/conferences/snc2007/site/

July 27, 2007, "Brain Biomechanics: Mathematical Modelling of Hydrocephalus and Syringomyelia Centre for Mathematical Medicine at the Fields Institute"
www.fields.utoronto.ca/programs/scientific/CMM/07-08/biomechanics/

July 29-August 1, 2007, "International Symposium on Symbolic and Algebraic Computation (ISSAC2007)", University of Waterloo
http://www.cs.uwaterloo.ca/%7Eissac07/

August 12-16, 2007, "2nd International Conference on Continuous Optimization ICCOPT - MOPTA07", McMaster University
http://iccopt-mopta.mcmaster.ca/

August 13-17, 2007, "6th International Conference on Unconventional Computation", Queen's University
www.cs.queensu.ca/uc07/

August 13-24, 2007, "Summer School on Operator Algebras", University of Ottawa
www.fields.utoronto.ca/programs/scientific/07-08/opalg_school/

August 27-29, 2007, "Automata 2007, 13th International Workshop on Cellular Automata", Fields Institute
www.fields.utoronto.ca/programs/scientific/07-08/automata07/

September 4-7, 2007, "Data Assimilation Workshop", Fields Institute
www.fields.utoronto.ca/programs/scientific/07-08/data_assim/

September 17 - 21, 2007, "Workshop on Free Probability, Random Matrices, and Planar Algebras", Fields Institute
www.fields.utoronto.ca/programs/scientific/07-08/operator_algebras/free/

September 22-24, 2007, "Geometrization of Probability Workshop", University of Ottawa
www.fields.utoronto.ca/programs/scientific/07-08/geometrization/

October 29 - November 2, 2007, "Workshop on von Neumann Algebras"
www.fields.utoronto.ca/programs/scientific/07-08/operator_algebras/

November 9-10, 2007, "Conference in Honour of the 60th birthday of Professor Andreas R. Blass", Fields Institute
www.fields.utoronto.ca/programs/scientific/07-08/blassconference/

November 12- 16, 2007, "Workshop on Structure of C*-Algebras"
www.fields.utoronto.ca/programs/scientific/07-08/operator_algebras/

December 11 - 15, 2007, "Workshop on Operator Spaces and Quantum Groups"
www.fields.utoronto.ca/programs/scientific/07-08/operator_algebras/

researcher can be an even greater *mensch*.

My time in Alberta changed me forever (I still have a couple of cowboy hats and oversized belt buckles to prove it). I had been exposed to the intoxicating effects of discrete mathematics, and have been hooked ever since. It is entirely fitting that a brand new discrete mathematics conference is starting up out west. I am part of the executive committee for the first Canadian Discrete and Algorithmic Mathematics Conference (CanaDAM), which will be held on May 28-31, 2007 at the Banff Conference Center.

Those of us on the executive committee and others have felt over the years that there is a need for a uniquely Canadian conference on discrete mathematics. The scope of this new conference includes the theory and application of discrete structures. Indeed research in discrete mathematics can be viewed as a living, growing network involving links within discrete mathematics and to such diverse areas as cryptography, computer science, large-scale networks and biology. This conference brings together researchers from the various disciplines with which discrete and algorithmic mathematics interact. Areas of interest for the conference include the whole gamut of discrete mathematics: graphs and digraphs, hypergraphs, ordered sets, designs, coding theory, enumeration, discrete optimization, combinatorial algorithms and applications of discrete and algorithmic mathematics, including (but not limited to) web graphs, computational biology, telecommunication networks, and information processing.

The conference already has an impressive slate of invited speakers that mixes not only academia and industry, but pure, applied and algorithmic discrete mathematics: Valerie King (University of Victoria), Janos Pach (City College and Courant Institute), Bill Pulleyblank (IBM Research), David Sankoff (University of Ottawa), Vera Sos (Hungarian Academy of Sciences), Peter Winkler (Dartmouth) and Xuding Zhu (National Sun Yat-sen University). More information on the conference can be found at `http://www.cs.ualberta.ca/»mreza/CANADAM`. Having spent time in Alberta, I can tell you that there is no more beautiful place to be in Canada than Banff.

So come join us in May for what promises to be an exhilarating conference, one of many to come. I hope to see you there, with or without your Stetson, pardner!

CALL FOR NOMINATIONS
CJM/CMB - Associate Editors

The Publications Committee of the CMS solicits nominations for Associate Editors for the Canadian Journal of Mathematics (CJM) and the Canadian Mathematical Bulletin (CMB). The appointment will be for five years beginning January 1, 2007. The continuing members (with their end of term) are below.

The deadline for the submission of nominations is April 15, 2007.

Nominations, containing a curriculum vitae and the candidate's agreement to serve should be sent to the address below.

APPEL DE MISES EN CANDIDATURE
JCM/BCM - Rédacteurs associés

Le comité des publications de la SMC sollicite des mises en candidatures pour des rédacteurs associés du Journal canadien de mathématiques (JCM) et Bulletin canadien de mathématiques (BCM). Le mandat sera de cinq ans et débutera le 1 janvier 2007. La liste des éditeurs qui sont en cours de mandat se trouve ci-dessous..

L'échéance pour proposer des candidats est le 15 avril 2007.

Les mises en candidature, accompagnées d'un curriculum vitae ainsi que du consentement du candidat(e), devrait être envoyées à l'adresse ci-dessous.

Address for Nominations / Addresse de mise en candidatures:

Juris Steprans, Chair / Président
CMS Publications Committee / Comité des publications de la SMC
Department of Mathematics, York University
N520 Ross, 4700 Keele Street
Toronto, Ontario M3J 1P3

`chair-pubc@cms.math.ca`

CURRENT MEMBERS / MEMBRES ACTUELS

CJM Editors-in-Chief / Rédacteurs-en-chef du JCM
H. Kim (Toronto) 12/2011; R. McCann (Toronto) 12/2011.

CMB Editors-in-Chief / Rédacteurs-en-chef du BCM
Nantel Bergeron (York) 12/2010; Jianhong Wu (York) 12/2010.

Associate Editors / Rédacteurs associés
K. Bezdek (Calgary) 12/2011; Steven Boyer (UQAM) 12/2008; J. Colliander 12/2011; W. Craig (McMaster) 12/2007; Luc Devroye (McGill) 12/2009; Alan Dow (York) 12/2010; George Elliott (Toronto) 12/2010; Pengfei Guan (McMaster) 12/2008; K. Hare (Waterloo) 12/2011; Stephen Kudla 12/2008; Thomas Ransford (Laval) 12/2009; Ravi Vakil (Stanford University) 12/2009.

May 31 – June 3 / du 31 mai au 3 juin
Delta Hotel, Winnipeg, Manitoba / Hôtel Delta, Winnipeg (Manitoba)
Host: University of Manitoba / Hôte : Université du Manitoba

Sessions

Algebraic Varieties with Group Actions
Variétés algébriques avec actions de groupes
Org: Jaydeep Chipalkatti (Manitoba)

Megumi Harada (MacMaster), Colin Ingalls (UNB), Kiumars Kaveh (Toronto), Jochen Kuttler (Alberta), Nicole Lemire (UWO), Hugh Thomas (UNB), Matthieu Willems (Toronto).

Banach Algebras and Abstract Harmonic Analysis
Algèbre de Banach et analyse harmonique abstraite
Org: Yong Zhang (Manitoba)

Constantin Costara (Laval), Antoine Derighetti (Lausanne, Switzerland), Brian Forrest (Waterloo), Colin C. Graham (UBC), Niels Gronbaek (Copenhagen, Denmark), Zhiguo Hu (Windsor), Zinaida Lykova (Newcastle,UK), Tianxuan Miao (Lakehead), Matthias Neufang (Carleton), Chi-Keung Ng (Chern Inst. of Mathematics, Nankai Univ., China), Thomas Ransford (Laval), Zhong-Jin Ruan (Illinois - Urbana-Champaign), Nico Spronk (Waterloo), Ross Stokke (Winnipeg), Thomas V. Tonev (Montana-Missoula), Ali Ülger (Koc Univ., Turkey), Michael C. White (Newcastle, UK), Yong Zhang (Manitoba).

Complex Function Theory
Théorie des fonctions complexes
Org: Ian Graham (Toronto), Eric Schippers (Manitoba)

Roger Barnard (Texas Tech), Tom Bloom (Toronto), Maritza Branker (Niagara), Richard Fournier (CRM), David Herron (Cincinnati), Gabriela Kohr (Babes-Bolyai, Romania), Daniela Kraus (Würzburg, Germany), David Minda (Cincinnati), Jerry Muir Jr. (Scranton), Rajesh Pereira (Saskatchewan), David Radnell (American Univ. of Sharjah, UAE), Thomas Ransford (Laval), Oliver Roth (Würzburg, Germany), Stephan Ruscheweyh (Würzburg, Germany), Alex Solynin (Texas Tech), Ted Suffridge (Kentucky), Dror Varolin (Stony Brook), Brock Williams (Texas Tech).

Computer Algebra and Computer Algebra Systems
L'algèbre computationnelle et systèmes d'algèbre computationnelle
Org: Michael Monagan (SFU)

Finite Combinatorics
Combinatoire finie
Org: Robert Craigen (Manitoba), David Gunderson (Manitoba)

Richard Guy (Calgary), Jonathan Jedwab (SFU), Hadi Kharaghani (Lethbridge), William Kocay (Manitoba), Ben Li (Manitoba), Vaclav Linek (Winnipeg), Wendy Myrvold (Victoria), Ortrud Oellerman (Winnipeg), Ranganathan Padmanabhan (Manitoba), Bruce Reed (McGill), Douglas Stinson (Waterloo).

Mathematical Algorithms for Medical Imaging
Algorithmes mathématiques pour l'imagerie médicale
Org: Sima Noghanian (Manitoba)

Jorge Alpuche (CancerCare Manitoba), Ali Ashtari (Manitoba), Homa Fashandi

Richard Guy (Calgary), Jonathan Jedwab (SFU), Hadi Kharaghani (Lethbridge), William Kocay (Manitoba), Ben Li (Manitoba), Vaclav Linek (Winnipeg), Wendy Myrvold (Victoria), Ortrud Oellerman (Winnipeg), Ranganathan Padmanabhan (Manitoba), Bruce Reed (McGill), Douglas Stinson (Waterloo).

Mathematical Biology
Biologie mathématique
Org: Gerda de Vries (Alberta), Frithjof Lutscher (Ottawa)

Caroline Bampfylde (Alberta), Jacques Belair (Montreal), Luciano Buono (UOIT), Eric Cytrynbaum (UBC), Raluca Eftimie (Alberta), Frank Hilker (Alberta), Anmar Khadra (UBC), Frithjof Lutscher (Ottawa), Fahima Nekka (Montreal), Alex Potapov (Alberta), Robert Smith (Ottawa), Philippe Tracqui (IMAG, Grenoble, France), Rebecca Tyson (UBC-Okanagan), Allan Wilms (Guelph), Kate Fang Zhang (UNB).

Mathematical / Computational Finance
Finance mathématique et computationelle
Org: Ruppa K. Thulasiram (Manitoba)

Joe Campolieti (Wilfrid Laurier), Tahir Choulli (Alberta), Ulrich Horst (UBC), Ali Lazrak (UBC), Alex Paseka (Manitoba), Luis Seco (Risk Lab), Ruppa K. Thulasiram (Manitoba), LiQun Wang (Manitoba).

Mathematical Immunology
Mathématiques en Immunologie
Org: Robert Smith (Ottawa), Beni M. Sahai (Cadham Provincial Laboratory)

Rafi Ahmed (Emory), Rustom Antia (Emory), Daniel Coombs (UBC), Denise Kirschner (Michigan State), Robert Smith (Ottawa), Dominik Wodarz (California - Irvine).

Mathematical Physics
Physique mathématique
Org: Richard Froese (UBC), Tom Osborn (Manitoba)

Twareque Ali (Concordia), Marco Bertola (Concordia), Rainer Dick (Saskatchewan), Stephan Gustavson (UBC), John Harnad (CRM), Nan-Kuo Ho (National Cheng Kung Univ., Taiwan), Lisa Jeffrey (Toronto), MArco Merkli (McGill), Rob Milson (Dalhousie), David Rowe (Toronto).

Mathematics Education
L'éducation mathématique
Org: Abba Gumel (Manitoba), Randall Pyke (SFU)

Mathematics of Infectious Diseases
Modélisation mathématique des maladies infectieuses
Org: Abba Gumel (Manitoba)

Christopher Bowman (Inst. for Biodiagnostics), Gerardo Chowell-Puente (Los Alamos National Laboratory), Elamin Elbasha (Merck Inc.), Horacio Gomez-Acevedo (Tougaloo College), Hongbin Guo (Alberta), Mudassar Imran (Arizona State), Edward Lungu (Botswana), Tufail Malik (Arizona State), Ronald Mickens (Clark Atlanta), Miriam Nuno (Harvard), Chandra Podder (Manitoba), Oluwaseun

Sharomi (Manitoba), Baojun Song (Montclair State), Lin Wang (UBC), James Watmough (UNB), Matthias Winter (Brunel, UK), Huaiping Zhu (York).

Model Theory and its Applications
Théorie des modèles et ses applications
Org: Bradd Hart (McMaster), Thomas Kucera (Manitoba), Rahim Moosa (Waterloo)

John Baldwin (Illinois - Chicago), Paul Bankston (Marquette University), Alf Dolich (Illinois - Chicago), Alina Duca (Manitoba), Dragos Ghioca (McMaster), Bradd Hart (McMaster), Dierdre Haskell (McMaster), Ivo Herzog (Ohio State; Lima), Thomas Kucera (Manitoba), Salma Kuhlmann (Saskatchewan), Chris Laskowski (Maryland), Rahim Moosa (Waterloo), Philipp Rothmaler (CUNY-Bronx), Thomas Scanlon (California - Berkeley), Patrick Speissegger (McMaster), Yevgeniy Vasilyev (Windsor).

Network Algorithms
Algorithmes des réseaux
Org: Evangelos Kranakis (Carleton)

Additional information on this session is available at
`http://www.scs.carleton.ca/~kranakis/IT/IT-07.html`.

Anthony Bonato (Wilfrid Laurier), Mark Coates (McGill), Stefan Dobrev (Ottawa), George Karakostas (McMaster), Michel Paquette (Carleton), Yiqiang Q. Zhao (Carleton).

Nonlinear Methods in Computational Mathematics
Méthodes nonlinéaires en mathématiques computationnelles
Org: Kirill Kopotun (Manitoba)

A. Bass Bagayogo (Univ. College of Saint-Boniface), Oleg Davydov (Strathclyde, UK), Zeev Ditzian (Alberta), Jacek Gilewicz (Centre de Physique Theorique, France), Tom Hogan (The Boeing Company), Yingkang Hu (Georgia Southern), Francisco-Javier Muñoz-Delgado (Universidad de Jaén, Spain), Bojan Popov (Texas A&M), Andriy Prymak (Alberta), Ping Zhou (St. Francis Xavier).

Quantum Information Theory
Théorie de l'information quantique
Org: Richard Cleve (Waterloo)

Gilad Gour (Calgary), Patrick Hayden (McGill), Debbie Leung (Waterloo), Barry Sanders (Calgary), Alain Tapp (Montréal).

Representations of Finite and Algebraic Groups
Représentations des groupes finis et des groupes algébriques
Org: Gerald Cliff (Alberta), Anna Stokke (Winnipeg)

Peter Campbell (Bristol, UK), Xueqing Chen (Wisconsin - Whitewater), Jaydeep Chipalkatti (Manitoba), Allen Herman (Regina), Greg Lee (Lakehead), David McNeilly (Alberta), Fernando Szechtman (Regina), Qianglong Wen (Alberta).

Resource Allocation Optimization
Optimisation d'allocation de ressources
Org: Binay Bhattacharya (SFU) Abraham Punnen (SFU)

Robert Benkoczi (Queen's), Prosenjit Bose (Carleton), Harvey Greenberg (Colorado), David Kirkpatrick (UBC), Pat Morin (Carleton), Katta G. Murty (Michigan), Godfried Toussaint (McGill).

Statistical Learning
Apprentissage statistique
Org: Yoshua Bengio (Montreal)

Julie Carreau (Montreal), Ali Ghodsi (Waterloo), Nicolas Le Roux (Montreal), Ruslan Salakhutdinov (Toronto), Dana Wilkinson (Waterloo).

Contributed Papers
Communications libres
Org: Ross Stokke (Winnipeg)

Papers of 20 minutes duration are invited. For an abstract to be eligible, the abstract must be submitted online (www.cms.math.ca/Events or www.mitacs.ca/AC07) before April 15, 2007. The abstract must be accompanied by its contributor's registration form and payment of the appropriate fees. To better assist the organizers, please include the Primary (2000) AMS Classification (http://www.ams.org/msc/).

Nous lançons un appel de communications libres de 20 minutes chacune. Les résumés devront respecter nous parvenir au plus tard le 15 avril (Veuillez utiliser le formulaire électronique à www.cms.math.ca/Reunions ou www.mitacs.ca/AC07). Nous demandons à chacun de joindre au résumé le formulaire d'inscription et le règlement des frais pertinents. Pour faciliter la tâche des organisateurs, veuillez préciser la classification de sujets AMS 2000 (http://www.ams.org/msc/).

Poster Session
Session d'Affiches

We encourage students and postdoctoral fellows to display posters to present their recent work and results. This gives a chance for media, professors, and students of all levels to gain an appreciation for the type of projects being undertaken in the field of mathematical sciences. Posters are judged during the conference, and prizes are awarded for the top ten posters.

Nous encourageons les étudiants et chercheurs postdoctoraux à présenter des affiches de même que leurs plus récents travaux et résultats de recherche. Ces présentations offrent la possibilité aux médias, aux professeurs et aux étudiants de tous les niveaux de se familiariser avec les types de projets de recherche dans le domaine des mathématiques. Les affiches seront jugées pendant la conférence, et des prix seront attribués pour les dix affiches meilleures.

Scientific Directors / Directeurs du Congrès

Don Dawson (Carleton)
ddawson@math.carleton.ca

Fereidoun Ghahramani (Manitoba)
fereidou@cc.umanitoba.ca

MITACS

Local Arrangements / Logistique locale:

Abba Gumel (Manitoba)

The 2006 reports from the standing committee chairs are in the language provided by the chair. The President's and Advancement of Mathematics Committee as well as the Education, Endowments Grants, Finance, Publications, Nominating, Research and Student committee reports will appear in the May issue of the CMS Notes.

Les rapports sont livrés dans la langue de rédaction d'origine. Les rapports du président, du comité pour l'avancement des mathématiques ainsi que les rapports des comités d'éducation, comité d'attribution des bourse du fonds de dotation, comité des finances, publications, comité des mises en candidature, recherches et étudiants paraîtront dans le numéro de mai des Notes de la SMC.

EXECUTIVE DIRECTOR'S ANNUAL REPORT

General:

In 2006 there were a number of staff changes at the Executive Office in Ottawa. Following approval by the Board of Directors, the Society is devoting more resources to fund raising activities. In March 2006, Mark Bowman was hired under a two-year contract as the CMS Development Coordinator and Queen's Advancement External Services (QAES) have been engaged on a consultative basis.

Nathalie Blanchard, Assistant to the Executive Director, left the CMS in June 2006 to become a Graphics Design Consultant. Although Nathalie is no-longer a full-time member of the Executive Office staff, she continues to provide assistance, on a contract basis, for the design of the Society's meeting posters and programs, brochures, and other materials. Nathalie is also involved with the re-design of the Society's web site and some of the newly-designed web pages will be released during 2007. Susan Latreille took over as Assistant to the Executive Director in June 2006. In addition to performing the duties required of the Assistant, Susan is also responsible for assisting with the production of each issue of the CMS Notes, the administrative aspects of the Canadian Mathematical Olympiad, Canada's participation at the annual International Mathematical Olympiad, the CMS elections, and assisting with the various award and media events.

In November 2006, Susan Duncan, the Administrative Clerk, left the CMS and Rachael Cunningham was hired to fill the position, effective January 2007. The list of the Executive Office staff is given on page 18 and I would like to acknowledge and thank all of the staff for their help and support.

Since late 2004, the CMS Executive Office has been providing membership and related services for the Statistical Society of Canada (SSC). The current arrangements will be reviewed and a new agreement negotiated in 2007. In September 2006, the SSC approached the CMS to create and administer an On-line Registration System for the SSC annual meetings. A special agreement was developed and approved in December 2006. Thanks to the important efforts of Alan Kelm, CMS Web Services Manager, the new system has been developed and, even though there were a number of unforeseen factors that impacted the implementation, the new system was launched in February 2007.

I am happy to report that the campaign to attract new members and to retain existing members continues to be successful. This is due to the efforts of the membership and publications staff (Liliane Sousa and Tina LaPage) who have also been focusing on providing more direct contact with the subscribers and agents for the Society's periodicals. It is hoped that this approach will help to retain subscribers and to reduce the natural decline in periodical subscriptions.

Effective June 30, 2006, Eddy Campbell (Memorial) ended his term as President and Thomas Salisbury (York) took over. I wish to acknowledge the valuable leadership and support of Eddy during his two-year term as President, particularly for spear-heading the Society's enhanced fund raising strategy. Also in June 2006, Arthur Sherk ended his thirteen-year term as CMS Treasurer. The CMS was pleased that David Rodgers agreed to assume the role of Treasurer, effective July 1, 2007. I have been very grateful to Arthur for his counsel and superior service as Treasurer throughout his term and the Society was privileged to honour Arthur at the CMS Winter Meeting Banquet in Toronto in December.

Finances and Fund Raising:

At the Board of Directors Meeting in December 2005, the Terms of Reference for the CMS Endowed Funds including the Principles for the Preservation of Capital were approved. In 2006, the Board approved the creation of a CMS Contingency Fund and the terms of reference for this Fund, as well as the amounts to be allocated to the CMS Endowment Fund and CMS Contingency Fund. The terms of reference for a new standing committee, the Invested Funds Committee, were approved, as were revisions to the terms of reference and membership of the Finance Committee. The Invested Funds Committee will be responsible for the Society's invested funds and for determining the annual allocations of the annual income from the CMS Endowed Funds. In the short-term, the strategy for the CMS Contingency Funds will be the same as that for the

Endowed Funds. The creation of a Contingency Fund and an Invested Funds Committee will allow the Endowed Funds to be managed transparently as true endowments, thereby providing greater accountability to donors.

At request of the auditors, a review of the annual allocations and costs of life-time memberships has been conducted. An Ad-hoc Committee of the Finance Committee was formed comprised of David Bates (Chair), Jamie Mingo, Yvette Roberts, the Treasurer, and the Executive Director and with the responsibility to consider proper accounting methods and pricing for lifetime memberships. In December 2006, the Board of Directors accepted the recommendations of the Ad-hoc Committee. The Balance Sheet will now include a liability for life-time memberships which will be re-calculated annually. Also, the fees for life-time memberships have been revised and, effective 2007 will range from $3,000 for members under 35 years old to $1,500 for those members over 65 years old. Thanks are due to David Bates for his excellent work with this review of life-time memberships.

At the end of 2007, the CMS changed its financial software and I wish to commend Yvette Roberts, CMS Accountant, for her work with this significant change and in implementing all of the changes to the accounting operations resulting from the changes mentioned above, as well as those necessary for the financial services to the SSC.

The 2006 fund raising campaign was quite successful. The CMS is grateful for all those members who donated to one of our activities, many making significant increases in their annual contribution. Also a number of special donations were received for the Society's competitions programs. For 2007, NSERC PromoScience has decided not to renew its support for the CMS Math Camps Program and the CMS is also looking for a new Title Sponsor for this program. These and other factors will result in significant efforts being needed to meet the 2007 fund raising targets.

Publishing Activities:

As has been the case for many years, all of the Society's periodicals appeared on-time or well ahead of schedule. This could not be accomplished without the significant efforts of all of the editors-in-chief, the members of the various editorial boards and particularly the staff of the CMS Publications Office in Winnipeg, under the direction of Craig Platt (Manitoba). The change in Executive Office personnel mentioned previously did not cause any delays in the production of the CMS Notes and I wish to thank Susan Latreille, S. Swaminathan (Dalhousie) and Robert Dawson (St. Mary's) for their help with the transfer. Henri Darmon and Niky Kamran (McGill) ended their five-year terms as Editors-in-Chief of the Canadian Journal of Mathematics and the Society is indebted to them for their excellent leadership during the past five years. The new Editors-in-Chief are Robert McCann and Henry Kim (Toronto).

The past year has seen significant expansion of the Society's publication activities.

The CMS Book Series with Springer continues to be very successful. A total of 26 books have been released with several volumes having sales of over 1000 copies to-date. At least two volumes are scheduled to appear in 2007 and three other volumes are under contract.

Volume VI (*Problems for Mathematics Leagues – II*) in the ATOM (A Taste of Mathematics) Series was published in 2006 and volume VII should be released in early 2007.

The agreement with A.K. Peters for a new series, the CMS Treatises in Mathematics, has been approved and two contracts have been signed. The CMS will act as the publisher and be responsible for the production of each volume in the series with A.K. Peters responsible for marketing and promotion. The first book in this series will be published in 2007. The Editorial Board for the CMS Treatises in Mathematics consists of James Arthur (Toronto), Ivar Ekeland (UBC), Arvind Gupta (Simon Fraser), Barbara Keyfitz (Fields/Houston), and François Lalonde (Montréal).

The CMS has also entered into a co-publishing agreement with the Mathematical Association of America for a series of books in *problem solving*. The initial books in this series will feature the wealth of problems posed by Murray Klamkin and some of will feature a collection from some of the ATOM books. The first volume in this series should appear in 2007.

Meetings:

The 2006 Summer Meeting was hosted by the University of Calgary, and the 2006 Winter Meeting, by the University of Toronto. Thanks go to the Meeting Directors: Claude Laflamme (Calgary) and Ian Graham (Toronto), the Chair of Local Arrangements: Tony Ware (Calgary) and Erich Ellers (Toronto), and to the many session organizers for all their efforts in making both meeting very successful.

The First Joint Meeting between the Canadian Mathematical Society and the Sociedad Matemática Mexicana (SMM) took place from September 21-23, 2006 in Guanjarto, Mexico. There were more than 225 participants and work of the Scientific Committee consisting of Alejandro Adem (Chair), Andrew Granville, and Walter Craig representing the CMS, and J.C. Gómez Larrañaga (Chair), Lourdes Palacios, and Fernando Brambila representing the SMM contributed to a most successful first joint meeting. The second Joint CMS/

SMM Meeting is scheduled to take place in Vancouver in August 2009.

Although the CMS Executive Office, particularly Gertrud Jeewanjee, Meeting Coordinator, provides considerable level of assistance, all of CMS meetings depend on the support of the host university and the research institutes. The CMS is very grateful to all those who helped make our 2006 meetings extremely successful.

Thanks:

The Society's continues to expand its activities on many levels and this would not be possible without the significant help and support of the members, especially those and others who volunteer on CMS committees and editorial boards. All have helped make 2006 a very productive and successful year.

CMS Executive Office Staff:

Mark Bowman (Development Coordinator)
Alan Kelm (Web Services Manager)
Rachel Cunningham (Administrative Clerk)
Gertrud Jeewanjee (Meetings Coordinator)
Tina LaPage (Membership & Publications Clerk)
Susan Latreille (Assistant to the Executive Director)
Yvette Roberts (Accountant)
Liliane Sousa (Membership & Publications Agent)

RAPPORT ANNUEL 2007 DU DIRECTEUR ADMINISTRATIF

Généralités :

En 2006, nous avons eu beaucoup de roulement au bureau administratif à Ottawa. Avec l'approbation du Conseil d'administration, la Société se consacre davantage à ses activités de financement. En mars 2006, nous avons recruté Mark Bowman à titre de coordonnateur du développement pour un contrat de deux ans et fait appel au service d'avancement externe (QAES) de l'Université Queen's sur une base consultative.

Nathalie Blanchard a quitté son poste d'adjointe du directeur administratif en juin 2006 pour s'installer en tant que graphiste-conseil. Même si elle ne fait plus partie de la permanence du bureau administratif, Nathalie continue de nous aider à contrat (affiches et programmes de Réunions, brochures, etc.). Elle participe aussi à la réfection de notre site internet, dont les nouvelles pages seront en partie dévoilées durant l'année en cours. Susan Latreille est entrée en fonction comme adjointe du directeur administratif en juin 2006. En plus des tâches dévolues à ce poste, elle s'occupe du soutien à la production des Notes de la SMC, des aspects administratifs de l'Olympiade mathématique du Canada, de la participation annuelle du Canada à l'Olympiade internationale de mathématiques et de l'organisation de nos élections. Elle intervient aussi dans l'organisation de nos remises de prix et de nos activités médiatiques.

En novembre 2006, Susan Duncan, a quitté son poste de commis à l'administration, repris par Rachael Cunningham en janvier 2007. J'aimerais remercier tous les membres du personnel du bureau administratif (liste en page YYY) de leur aide et de leur soutien.

Depuis la fin 2004, notre bureau offre des services administratifs à la Société statistique du Canada (SSC). L'entente actuelle sera renégociée dans le courant de l'année. En septembre 2006, la SSC a confié à la SMC le mandat de créer et d'administrer un système d'inscription en ligne pour ses congrès annuels. Une entente spéciale a été négociée et approuvée en décembre 2006. Le nouveau système a été développé sous la houlette d'Alan Kelm, responsable des services web de la SMC. Malgré tous les impondérables venus compliquer sa mise en service, le système a été lancé en février 2007.

À ma grande joie, nos efforts pour recruter de nouveaux membres et maintenir nos effectifs continuent de porter leurs fruits. Merci au personnel des services aux membres et des publications (Liliane Sousa et Tina LaPage), qui s'efforcent en outre d'entretenir des liens plus étroits avec les abonnés et les distributeurs de nos publications. Espérons que cette stratégie nous aidera à garder nos abonnés et à freiner la baisse naturelle des abonnements à nos publications.

En date du 30 juin 2006, Eddy Campbell (Memorial) a terminé son mandat à la présidence et Thomas Salisbury (York) a pris le relais. Je tiens à remercier Eddy pour son leadership et son soutien précieux durant ses deux années de mandat, et notamment pour son rôle de premier plan dans notre nouvelle stratégie de financement. Juin 2006 marque aussi le départ d'Arthur Sherk après 13 années de service à la trésorerie. La SMC se réjouit que David Rodgers accepte de prendre le relais à compter du 1er juillet 2007. Je suis très reconnaissant à Arthur de ses judicieux conseils et de ses bons services tout au long de son mandat. La Société a eu l'honneur de lui rendre hommage au banquet de la Réunion d'hiver de Toronto, en décembre.

Finances et collecte de fonds :

En décembre 2005, le Conseil d'administration a approuvé les modalités du fonds de dotation de la SMC et les principes de conservation du capital. En 2006, le Conseil a approuvé la création d'un fonds de prévoyance et les modalités de ce fonds, ainsi que les sommes à affecter au fonds de la SMC et au fonds de prévoyance. Le Conseil a également approuvé le mandat d'un nouveau comité permanent, le Comité des investissements, ainsi que le mandat révisé et la composition

du Comité des finances. Le Comité des investissements s'occupera des investissements de la SMC et de la répartition annuelle des revenus du fonds de dotation. À court terme, la stratégie pour le fonds de prévoyance sera la même que pour le fonds de dotation. La création d'un fonds de prévoyance et d'un Comité des investissements garantira la gestion transparente du fonds de dotation et témoigne d'une responsabilité accrue envers les donateurs.

À la demande des vérificateurs, nous avons reconsidéré la répartition annuelle et les cotisations à vie. Un comité spécial du Comité des finances – David Bates (président), Jamie Mingo, Yvette Roberts, le trésorier et le directeur administratif – a été chargé de proposer des méthodes comptables appropriées et de réviser les cotisations à vie. En décembre 2006, le Conseil d'administration a accepté les recommandations du comité spécial. Le bilan comportera désormais un élément de passif pour les cotisations à vie, qui sera recalculé annuellement. De même, les cotisations à vie ont été révisées : à compter de 2007, elles varieront de 3 000 $ pour les membres de moins de 35 ans à 1 500 $ pour les membres de plus de 65 ans. Merci à David Bates pour son excellent travail dans le dossier de la révision des cotisations à vie.

À la fin de 2007, nous avons adopté un nouveau logiciel de gestion financière, et je tiens à féliciter Yvette Roberts, notre comptable, qui a piloté cette importante transition et apporté les changements nécessaires au niveau de notre comptabilité et de nos services financiers à la SSC.

La campagne de financement 2006 a donné d'assez bons résultats. De nombreux membres ont augmenté sensiblement leur contribution annuelle, et nous remercions tous ceux et celles qui ont fait un don à l'une ou l'autre de nos activités. De plus, nous avons reçu de nombreuses contributions spéciales pour les concours de la SMC. Étant donné que le programme PromoScience du CRSNG a décidé de ne pas renouveler son soutien aux camps mathématiques de la SMC en 2007, nous sommes à la recherche d'un nouveau commanditaire en titre pour ce programme. Pour cette raison et pour d'autres, nous devrons travailler très fort pour atteindre nos objectifs de financement en 2007.

Activités de publication :

Comme c'est le cas depuis plusieurs années, tous les périodiques de la Société ont paru à la date prévue ou même bien avant. Une telle promptitude n'aurait pas été possible sans le travail considérable de tous les rédacteurs en chef, des membres des comités de rédaction et, en particulier, du personnel du bureau des publications de la SMC à Winnipeg, sous la direction de Craig Platt (Manitoba). Le roulement de personnel au bureau administratif n'a jamais retardé la production des Notes de la SMC, et je tiens à remercier Susan Latreille, S. Swaminathan (Dalhousie) et Robert Dawson (St. Mary's) de leur aide durant la transition. Henri Darmon et Niky Kamran (McGill) ont terminé leur mandat de cinq ans comme rédacteurs en chef du Journal canadien de mathématiques, et la Société tient à souligner la qualité de leur leadership durant toutes ces années. Les nouveaux rédacteurs en chef sont Robert McCann et Henry Kim (Toronto).

Les activités de publications de la SMC ont été très intenses dans la dernière année.
La collection « Ouvrages de mathématiques de la SMC », en collaboration avec Springer, demeure un franc succès : 26 ouvrages publiés, dont plusieurs titres vendus à plus de 1 000 exemplaires. Au moins deux autres titres paraîtront en 2007 et trois autres sont en préparation.

Le sixième volume de la collection ATOM (Aime-t-on les mathématiques), intitulé Problems for Mathematics Leagues – II a paru en 2006, et le septième volume devrait paraître début 2007.

L'entente avec A.K. Peters pour la nouvelle collection « Traités mathématiques de la SMC » a été ratifiée, et deux contrats ont été signés. La SMC sera l'éditeur de la collection et se chargera de la production de chaque volume, et A.K. Peters s'occupera du marketing et de la promotion. Le premier titre de cette collection paraîtra en 2007. La SMC est ravie de la composition du comité de rédaction de cette nouvelle collection : James Arthur (Toronto), Ivar Ekeland (UBC), Arvind Gupta (Simon Fraser), Barbara Keyfitz (Fields/Houston) et François Lalonde (Montréal).

La SMC a également signé une entente de publication en partenariat avec la MAA (Mathematical Association of America) pour une collection d'ouvrages sur la résolution de problèmes. Les premiers livres de cette collection porteront sur le grand nombre de problèmes posés par Murray Klamkin, et certains présenteront un regroupement de quelques-uns des ouvrages de la collection ATOM. Le premier titre de cette collection devrait paraître en 2007.

Réunions :

La Réunion d'été 2006 s'est tenue à l'Université de Calgary, et la Réunion d'hiver 2006, à l'Université de Toronto. Merci aux directeurs de ces Réunions, Claude Laflamme (Calgary) et Ian Graham (Toronto); aux présidents des comités de logistique, Tony Ware (Calgary) et Erich Ellers (Toronto); et aux nombreux organisateurs de sessions. Grâce à leurs valeureux efforts, ces Réunions ont été toutes deux couronnées de succès.

Notre premier congrès conjoint avec la Société mexicaine de mathématiques (SMM) a eu lieu du 21 au 23 septembre 2006 à Guanjarto, au Mexique. Il y avait plus de 225 participants,

et le travail du comité scientifique – pour la SMC : Alejandro Adem (président), Andrew Granville et Walter Craig; pour la SMM : J.C. Gómez Larrañaga (président), Lourdes Palacios et Fernando Brambila – a contribué au grand succès de ce premier congrès conjoint. Le deuxième congrès conjoint SMC-SMM aura lieu à Vancouver en août 2009.

Même si le bureau administratif -- en particulier Gertrud Jeewanjee, coordonnatrice des Réunions -- intervient beaucoup dans l'organisation des Réunions, toutes dépendent du soutien de l'établissement hôte et des instituts de recherche. La SMC doit une fière chandelle à toutes les personnes qui ont contribué à l'immense succès de ses Réunions en 2006.

Remerciements :
La Société ne saurait continuer de diversifier autant ses activités sans l'appui de ses membres, en particulier ceux et celles qui siègent aux différents comités de la SMC et aux comités de rédaction. Grâce à vous toutes et tous, 2006 aura été une année très fructueuse.

WOMEN IN MATHEMATICS COMMITTEE REPORT

Gerda de Vries (University of Alberta), Chair

The Committee on Women in Mathematics is charged with monitoring the status of women within the Canadian mathematical community, recommending actions that will help to ensure equitable treatment of women in the community, and encouraging the participation of women in mathematics at all levels.

The main activity of the Committee in 2006 was to host the third edition of the Connecting Women in Mathematics Across Canada (CWiMAC) workshop (held earlier in 2003 and 2005). This workshop brings together women in mathematics from many different levels (undergraduate and graduate students, postdoctoral fellows, and women in junior and senior faculty positions), with the aim of supporting women in the early stages of their career in the mathematical sciences. The third CWiMAC workshop was held December 7-8, 2006, at the Fields Institute, in conjunction with the CMS Winter Meeting in Toronto. Approximately 50 women participated in this workshop. The opening speaker was journalist and author Siobhan Roberts, who presented an overview of Donald Coxeter's relations with the women in his life. Mentorship was facilitated through informal pairings of junior and senior women at both dinner and lunch discussions.

The dinner and lunch discussions were preceded by presentations by Margaret Beattie (Mount Allison) and Wendy MacCaull (St. Francis Xavier). Postdoctoral fellows presented their research in 30-minute speaker sessions, and graduate students spoke about their research in a lively poster session. These research presentations showcased a broad range of mathematical topics, ranging from pure to applied mathematics and statistics. Last but not least, a panel discussion tackled issues affecting new researchers from a woman's point of view. Financial support for the workshop was provided by the Fields Institute, the CMS, and a generous anonymous individual. The money provided partial funding for travel and registration.

In addition, the Committee updated its terms of reference to reflect its current activities, and is in the process of revamping the Directory of Canadian Women in the Mathematical Sciences. It is anticipated that the new directory will be a valuable source of information about Canadian women in mathematics (the Committee receives requests for this information from time to time for speaker invitations, award nominations, etc.).

MATHEMATICAL COMPETITIONS COMMITTEE REPORT

Edward J. Barbeau (University of Toronto), Chair

Stewart G. Craven (Toronto District School Board)
Robert J.M. Dawson (Saint Mary's)
Kirill Kopotun (Manitoba)
Neal Madras (York)
Bruno Rémillard (HEC-Montreal)
Bill Sands (Calgary)
Bruce L.R. Shawyer (Memorial)
Daryl R. Tingley (UNB-Fredericton)
Ian VanderBurgh (Waterloo)
Graham P. Wright (Ottawa)

Introduction:
The Mathematical Competitions Committee (MCC) oversees the Society's involvement in mathematics contests. The Canadian Open Mathematics Challenge (COMC) and the Canadian Mathematical Olympiad (CMO) are sponsored and run by the Society. The MCC is responsible for Canada's participation in the Asian Pacific Mathematics Olympiad (APMO) and the International Mathematical Olympiad, and supervises the Mathematical Olympiad Correspondence Program (Olymon) and the Esso/CMS National Math Camp.

Most of the work of the MCC is done by its four sub-committees (COMC Committee, CMO Committee, IMO Committee, and the Correspondence Coordinator). Further information, including press releases, on most of the topics in this report can be found through the CMS Competitions web page `www.cms.math.ca/Competitions/` and `www.cms.math.ca/MediaReleases/`.

The Canadian Mathematical Olympiad:

The 38th Canadian Mathematical Olympiad (CMO) was written on March 29, 2006. A total of 79 competitors from over 50 schools wrote the 2006 CMO. The top winners in the 2006 Canadian Mathematical Olympiad were:

FIRST PRIZE and the Sun Life Financial Cup: Dong Uk (David) Rhee, McNally Composite High School Edmonton, AB; **SECOND PRIZE: Yufei Zhao**, Don Mills Collegiate Institute, Toronto, ON; **THIRD PRIZE: Shawn Eastwood**, Canadian International School, Singapore. **HONOURABLE MENTIONS** were awarded to: **Alan Guo**, O'Neill Collegiate and Vocational Institute, Oshawa, ON, **Kent Huynh**, University of Toronto Schools, Toronto, ON, **Viktoriya Krakovna**, Vaughan Road Academy, Toronto, ON, **Alexander Remorov**, Waterloo Collegiate Institute, Waterloo, ON, and **Thomas Tang**, A.Y. Jackson Secondary School, North York, ON.

A detailed report on the 2006 CMO, including the contest paper, solutions to the problems, and graders' reports is available at: `www.cms.math.ca/Competitions/CMO`.
The Society is indebted to many sponsors for the success of the CMO, but particularly to its dedicated and long-term major sponsor, Sun Life Financial.

The Asian Pacific Mathematics Olympiad:

The 18th Asian Pacific Mathematics Olympiad (APMO) was written on March 13, 2006. A total of 45 Canadian students wrote the exam. The top students were Yufei Zhao with a perfect score and Jeffrey Mo, who took second place but was not an official candidate. Our official team consisted of the top ten official students; it won a maximum set of awards, one gold, two silver, four bronze medals and 3 honourable mentions. Further details regarding the 2005 APMO are available at: `www.cms.math.ca/Competitions/APMO/`.

International Mathematical Olympiad:

The 47th International Mathematical Olympiad (IMO) took place in Ljubljana, Slovenia from July 6 to July 18, 2006. The Team Leader was Robert Morewood of the Crofton House School in Vancouver and the Deputy Team Leader was Naoki Sato of the Art of Problem Solving Inc. The team of six high school students ranked 15 out of 90 countries. Five team members, **Farzin Barekat** (Sutherland Secondary School, North Vancouver, British Columbia), **Viktoriya Krakovna** (Vaughan Road Academy, Toronto, Ontario), **Dong Uk (David) Rhee** (McNally High School, Edmonton, Alberta), **Peng Shi** (Sir John A. MacDonald Collegiate Institute, Agincourt, Ontario) and **Yufei Zhao** (Don Mills Collegiate Institute, Toronto, Ontario), won silver medals and **Yang (Richard) Peng** (Vaughan Road Academy, Toronto, Ontario) won a bronze medal.

Robert Morewood's Report on the 2006 IMO was published in the October 2006 issue of the CMS Notes. Yufei Zhao was named the 2006 Samuel Beatty Contestant to the IMO and his report can be found in the November 2006 issue of the CMS Notes.

We are grateful to York University for hosting the Winter Training Seminar, January 3 - 8, 2006. Fifteen students from across Canada attended this seminar. Thanks are due to York University, Department of Mathematics, for their hospitality and particularly to Neal Madras, Local Organizer, the Canadian Team Leader and Deputy Team Leader, the assistant trainers, Bill Sands (Calgary), Edward Barbeau (Toronto) and Adrian Tang (Calgary) and also to Hongmei Zhu and Alfred Pietrowski, both from York University, who took care of many little tasks that were crucial to ensure a successful seminar. Thanks are also due to Bethune College, and its Master Byron Wall and his wife Martha who served as "chaperones" during the Winter Training Seminar.

The Summer Training Seminar for the six Team members took place at Dalhousie University from June 24 to July 2. Five local students from Nova Scotia and New Brunswick also attended the training seminar from June 24 to June 27. On July 2, the team traveled to Slovenia to train with the Swedish and Luxembourg teams until July 10. The CMS is grateful for the hospitality and support from the Faculty of Science and the Department of Mathematics and Statistics, Dalhousie University and to Roman Smirnov, Dorette Pronk, Shannon Fitzpatrick, and J.P. Grossman for all their help with the 2006 Summer Training Seminar.

The Send-off Reception for the 2006 Canadian IMO team took place at Dalhousie University on July 27, 2006. Those present at the Send-off Reception included: Donna Karsten, Nova Scotia Department of Education; Sam Scully, Academic Vice-President, Dalhousie University; Jonathan Borwein, Director, Atlantic Association for Research in the Mathematical Sciences; Patrick Keast, Chair, Department of Mathematics and Statistics, Dalhousie University, and Graham Wright, Executive Director, Canadian Mathematical Society. A significant level of local and national media coverage was obtained for the 2006 Canadian IMO team.

More information regarding the 2006 IMO can be found at:
`www.cms.math.ca/MediaReleases/` and
`www.cms.math.ca/Competitions/IMO`.

Mathematical Olympiads Correspondence Program:

This program (Olymon) is a program whereby secondary students submit solutions to problems for marking. This year there were ten problem sets: five were constructed and marked by Edward Barbeau (University of Toronto), two by

Valeria Pandelieva of Ottawa, two by Lily Yen of Burnaby, BC and one by Rosu Mihai of Toronto. The number of respondents for each set was normally in the 10-15 range. All the Olymon problems with their solutions are posted at: www.cma.math.ca/Competitions/MOCP.

Esso/CMS National Math Camp:

The National Math Camp is designed primarily for younger Canadian students with at least two years remaining in high school and with the potential to compete at the Mathematical Olympiad level. Participation in the camp is by invitation only. It is intended for students in Grades 8-10.

The 2006 Esso/CMS National Math Camp took place at John Abbott College, (Québec) from July 2 – 8. Twenty two students attended the Camp, 12 from Ontario, three from Québec, three from British Columbia, two from Alberta, one from New Brunswick and one from Newfoundland. We are grateful to the organizer Daniel Gatien (John Abbott College) and Mathieu Dufour (UQAM) for all their work in making this a most successful camp. See the Education Committee report for information about other Math Camp activities.

The Canadian Open Mathematics Challenge:

November 2006 marked the eleventh writing of the COMC. It is a collaborative activity between the CMS and the Centre for Education in Mathematics and Computing at the University of Waterloo. This Contest has several purposes. First and foremost, it aims to encourage students in their exploration of mathematics and problem solving. Second, the COMC provides an enrichment activity for teachers to use with their students during the fall term. And third, the COMC is used by the CMS to identify students who will write the Canadian Mathematical Olympiad and who will attend, among other events, the Winter Training Seminar and the National Math Camp.

The 2006 COMC had a record number of over 6900 participants. The average mark on the paper was 31/80. **The top five students** were: Bo Cheng Cui (West Vancouver Secondary School, British Columbia), Jia Guo (O'Neill Collegiate Vocational Institute, Ontario), Yan Li (Dr. Norman Berthune Collegiate Institute, Ontario), Jeremy Pham (The Advanced Academy of Georgia, Georgia, U.S.A.), and Danny Shi (Sir Winston Churchill Secondary School, Alberta).

For outstanding performance in the 2006 COMC, the **provincial winners** are:

Alberta – Danny Shi, Sir Winston Churchill High School, Calgary; **British Columbia** – Bo Cheng Cui, West Vancouver Secondary School, West Vancouver; **Manitoba** – Kedi Wang, Fort Richmond Collegiate Institute; **New Brunswick** – Joe Kileel, Fredericton High School, Fredericton; **Newfoundland and Labrador** – Mark Yang, Prince of Wales Collegiate Institute, St. John's; **Nova Scotia** – Linhe Li, Queen Elizabeth High School, Halifax; **Ontario Central** – Sina Makaremi, John Fraser Secondary School, Mississauga; **Ontario East** – Jia Guo, O'Neill Collegiate Vocational Institute, Oshawa; **Ontario Metro** – Yan Li, Dr. Norman Bethune Collegiate Institute, Scarborough; **Ontario North** – Xinyang Zhang, Orillia District Collegiate Vocational Institute, Orillia; **Ontario West** – Andy Kong, Vincent Massey Secondary School, Windsor; **Prince Edward Island** – Yufeng Chen, Colonel Gray Secondary High School, Charlottetown; **Québec** – Ran Li, E.S. Honore-Mercier, Montreal; **Saskatchewan** – Bobby Xiao, Walter Murray Collegiate Institute, Saskatoon; **Northwest Territories** – Nicholas Coffin, F.H. Collins School, Whitehorse.

Thanks are due to the hard-working Problems Committee who annually ensures that the paper meets its varying goals. Further details are available at: www.cms.math.ca/Competitions/COMC/.
The Mathematical Competitions Committee (particularly its sub-committees) is very active. I would like to thank all members for their enthusiasm and hard work in making everything run so smoothly. No small measure of thanks is due to the staff at the CMS Executive Office and, in particular to the Executive Director Graham Wright, for their dedication.

INTERNATIONAL AFFAIRS COMMITTEE REPORT

Christiane Rousseau (Université de Montréal), Chair

The IAC is the liaison committee which serves as the voice of Canadian mathematics within the International Mathematical Union (IMU). It is officially a committee of the National Research Council (NRC). The NRC provides most of the funding used to support the participation of Canadian mathematics within the IMU.

During the year 2006 the Committee considered the following dossiers:

General Assembly of the IMU in Santiago de Compostella, August 2006:

The five Canadian delegates representing the country at the General Assembly were: Donald Dawson, Nassif Ghoussoub, Richard Kane, Barbara Keyfitz and Christiane Rousseau. The highlights of the General Assembly were the following: Bernard Hodgson (Laval) was elected General Secretary of ICMI (International Commission for Mathematical Instruction) for a third mandate. Jonathan Borwein remains Chair of the CEIC (Committee of Electronic Information and Communication) for two additional years. Nassif Ghoussoub is chairing a new Committee of mathematical institutes. Unfortunately, once again, no Canadian member was elected to the IMU Executive.

As Chair of the Canadian delegation, Christiane Rousseau reported to the Assembly that Canada was happy to support the Indian bid for ICM 2010 and announced that Canada would be bidding for ICM 2014.

Organization of the Canadian Reception in Madrid during ICM 2006:

The Canadian reception took place on the second day of ICM 2006 at the Hotel Ritz. The five hosts were the CMS, the three institutes (CRM, Fields, PIMS), and MITACS (Mathematics of Information Technology and Complex Systems). The reception was a success. The atmosphere was warm and the venue very nice. Stuart Savage from the Canadian Embassy was the Master of Ceremonies for the event. We had the pleasure to honour the Fields medalists Andrei Okounkov and Wendelin Werner, as well as Jon Kleinberg, recipient of the Nevanlinna Prize. Kiyoshi Itô was the recipient of the new Gauss Prize. He was represented at ICM and at our reception by his daughter Junko Itô. John Ball (outgoing President of the IMU) and Martin Grötschel (incoming Secretary of the IMU) were present, as well as Mrs. Mercedes Cabrera Calvo-Sotelo, Minister of Education and Science of Spain. Marc-André Varin from Palais des Congrès de Montréal noted, once again, Montreal's interest in hosting ICM 2014. Luis Seco (Toronto) put many efforts into ensuring participation of high-ranking Spanish dignitaries at the event.

Strategy to increase the number of Canadian speakers at ICM 2010:

The secretary of the IMU will launch an official call for input of the National Organizations to the Program Committee of ICM 2010. Considering past experience we can expect this call to take place around March 2008. The Committee decided on a strategy to prepare a dossier on Canadians having made significant contributions in the 5 years ending in 2007. In particular the following actions will be taken:

- An announcement in the CMS Notes and on the electronic distribution list cmath: winter 2007

- A call to department chairs: winter 2007

- A call to the Directors of the Institutes for consultation of their scientific panels: 2007

- Nomination of small subcommittees (2-3 persons) in each discipline covered by a session at ICM 2006. These subcommittees would be in charge of identifying the deserving Canadians in their discipline and write a short rational. Consultation of the Research Committee for the preparation of the final submission.

ELECTRONIC SERVICES COMMITTEE REPORT

David L. Rodgers, Chair

Jacques Carette	(McMaster)
George Pechske	(Alberta)
David Pike	(Memorial)
Jérémie Rostand	(Laval)
David Wehlau	(RMC)
Henry Wolkowicz	(Waterloo)
Jason Brown	(Dalhousie) - President's Delegate

The Electronic Services Committee (ESC) provides policy oversight for services provided by the Web Services Office (Ottawa) and Publications Office (Manitoba):

Web Services Office:

The resource allocation scheme continues to drive work assignments in four task categories: daily issues, web content, infrastructure, and projects. For 2006, allocation targets were essentially on track though the web content component has been somewhat squeezed.

Significant new responsibilities were assumed for the Executive Office database and accounting systems as well as for contract work for the Statistical Society of Canada.

The accounting system used by the Executive Office has been successfully replaced by AccPac, a product widely adopted by small and medium-sized organizations. It replaces what had become essentially an unsupported product.

There is increased reliance on pre-built open-source and commercial software, judicious out-sourcing of projects, use of spot consultants for special expertise, and on pruning non-core service offerings readily available through other venues.

Significant effort has been invested in database work that streamlines workflow in the Executive Office.
The Meetings database and web registration form have been extended and integrated.

- The CMS has undertaken development of a completely electronic registration and payment system for SSC meetings that will possibly also enhance capabilities for CMS meetings.

- SSC support has focused on converting a wholly spreadsheet application to a database driven environment that preserves spreadsheet reporting. The current contract is up for renewal effective June 2007.

- The CMS website now has a PayPal-based online donation capability that takes credit card transactions.

- The CMS website now has a PayPal-based shopping cart

that takes credit card transactions for books and Rich Media purchases.

·The Student Area has been integrated into the CMS website and content is maintained by the Student Webmaster.

·The linkage between the Publications page and Books & Rich Media maintained at Dalhousie University has been improved.
·A highly experienced programmer and web developer has been hired part-time through April 2007 and is expected to assist with the implementation of the CMS website re-design.

Publications Office:

·Issues of CMS journals continue to be produced on time with few problems.

·Progress was made on website redesign and a first-release version is scheduled as a 2007 deliverable.

·The CMS has signed an agreement with Google to put scanned and OCR converted issues of CMB/CJM prior to 1997 online for public access in an early 2007 timeframe.

·Working with ATOM series Editor-in-Chief, Bruce Shawyer, hyperlinked PDF versions of ATOM books Volumes I-VI have been produced.

·Arrangements were made with the editors of Comptes Rendus/Mathematical Reports of the Royal Society to have the CMS host their website.

The Committee joins Graham Wright in complimenting the work of both the Ottawa and Winnipeg offices, with special mention of their ability and willingness to juggle complex, multiple tasks.

DU BUREAU DU VICE-PRÉSIDENT

par Jason Brown
Université Dalhousie

La route vers l'Ouest

Je n'ai pas toujours été discret. J'ai entrepris mes études de premier cycle à l'Université de Calgary sans trop savoir vers où orienter mes études. Un goût prononcé pour les mathématiques et une répulsion envers le travail de laboratoire m'a poussé vers le côté mathématiques des sciences. À ma deuxième année d'études, Robert Woodrow, mon professeur de calcul, m'a suggéré de faire une demande d'emploi d'été au CRSNG pour travailler à un projet de recherche. De la recherche en mathématiques? Je n'avais jamais pensé à cela… Robert m'a suggéré d'étudier les graphes; je ne pouvais m'empêcher de penser aux courbes que j'avais vues et dessinées dans mon cours de calcul. Que pouvait-il bien y avoir de nouveau et d'intéressant à dire à ce sujet?

Je me trompais du tout au tout… J'ai compris le jour où Robert m'a assommé avec le classique de Bondy et Murty, Graph Theory with Applications (ça n'a pas fait mal bien longtemps). Je suis passé à travers le livre rapidement cet été-là et me suis littéralement épris des graphes, des réseaux et de tout ce qui est… discret. Peu après, je me suis attaqué à un problème de coloration de graphe, et j'ai constaté que je pouvais effectivement arriver à des résultats inédits.

Au début des années 1980, le département de mathématiques de l'Université de Calgary était assez unique; c'était un foyer d'activité intense en mathématiques discrètes. Il s'y tenait plusieurs séminaires par semaine en mathématiques discrètes, et de nombreux professeurs du département y consacraient leurs recherches, dont les professeurs Woodrow, Sands, Rival, Milner et Guy, pour n'en nommer que quelques-uns. Et on aurait dit que les professeurs dont les intérêts sortaient du domaine de la combinatoire étaient attirés vers les mathématiques discrètes de manières inusitées, mais extraordinaires. (Je me souviens très nettement d'une conférence de l'algébriste Hanafi Farahat qui, avec le combinatorialiste Norbert Sauer, avait eu recours à l'algèbre pour comprendre et étudier un problème de degrés dans un graphe. Je n'ai jamais oublié depuis qu'il était possible d'appliquer, d'une manière profonde, mystérieuse et, en bout de ligne, tout à fait pertinente, les notions d'un domaine apparemment bien éloigné pour en comprendre un autre.)

L'une des personnes les plus habiles pour établir de telles connexions était probablement Paul Erdos, que j'ai eu le privilège de rencontrer à cette époque. En fait, il semble que tous les spécialistes des mathématiques discrètes ont

visité le département. Évidemment, Paul Erdos faisait l'objet d'une adoration certaine lors de ses passages. Un jour, il m'a invité à dîner, moi tout seul, moi qui n'était à l'époque qu'un simple étudiant [???a mere ε at the time]. J'avais bien sûr entendu parler des travaux de Paul Erdos. J'étais plutôt tranquille au début du repas, mais il a réussi à me délier la langue. La conversation a pris un tour vraiment agréable. C'était extraordinaire de parler avec cet homme, de mathématiques, bien sûr, mais aussi de la vie en général.

Je me souviens aussi d'un jour où M. Erdos voulait se rendre au centre commercial pour se faire couper les cheveux. Je me suis fait un plaisir de l'y accompagner. L'intersection juste devant le centre commercial était très achalandée et, comme tout ce que l'on trouve à Calgary, très large. Pour Paul Erdos, les concepts mathématiques abstraits étaient de toute évidence très concrets, mais j'ai constaté qu'au contraire, il fallait considérer comme abstraits les feux de circulation, les voitures et les camions circulant à toute vitesse. Le professeur Erdos a traversé à l'intersection, sans attendre le feu vert, et je l'ai suivi en priant le ciel. Je ne voulais pas être le jeune mathématicien dont on se souviendrait comme étant celui qui accompagnait Paul Erdos le jour où il est mort en traversant la rue. En le suivant ainsi, j'ai soudain compris qu'il avait sûrement fait cela très, très souvent sans jamais subir d'accident grave. C'était plutôt moi qui devait m'inquiéter!

Un dernier épisode a conclu cette journée. Paul Erdos m'a demandé de l'accompagner à la bibliothèque pour retrouver un de ses anciens articles afin de se remémorer les détails d'un résultat. Il avait une vague idée de la revue et du volume où son article avait été publié. Tout en parcourant les rayons, il m'a envoyé chercher son article. Les numéros de la revue qu'il m'avait donnés arrêtaient avant le numéro qu'il m'avait suggéré. Quand je suis retourné le voir les mains vides, il s'est impatienté. Je n'ai rien dit, mais quand il a vérifié lui-même sur les étagères et qu'il a fait la même constatation que moi, il s'est tourné vers moi est s'est excusé. Le grand Erdos m'a fait des excuses à moi, un simple ε. J'ai appris ce jour-là qu'un grand chercheur pouvait être un bien plus grand mensch.

Mon passage en Alberta m'a transformé à jamais (j'ai encore quelques chapeaux de cowboy et ceintures de cuir à boucle démesurée pour le prouver). J'y ai été exposé aux effets enivrants des mathématiques discrètes, et j'y suis resté accroché. À mon sens, il est tout à fait approprié qu'un tout nouveau congrès sur les mathématiques discrètes voit le jour dans l'Ouest. Je fais partie du comité exécutif du premier congrès CanaDAM (Canadian Discrete and Algorithmic Mathematics Conference), qui se tiendra du 28 au 31 mai 2007 au Centre des congrès de Banff.

Mes collègues du comité exécutif et d'ailleurs pensaient depuis plusieurs années qu'un congrès typiquement canadien sur les mathématiques discrètes répondrait à un besoin. Ce nouveau congrès couvrira tout le spectre de la théorie et de l'application des structures discrètes. Bien sûr, il faut voir la recherche en mathématiques discrètes comme un réseau vivant d'interconnexions au sein même du domaine des mathématiques discrètes et entre ce domaine et des domaines aussi différents que la cryptographie, l'informatique, les grands réseaux et la biologie. Ce congrès rassemblera des chercheurs des disciplines qui ont tissé des liens avec mathématiques discrètes et algorithmiques. Entre autres domaines d'intérêts du congrès, mentionnons : les graphes et les digraphes, les hypergraphes, les ensembles ordonnés, designs, la théorie des codes, l'énumération, l'optimisation discrète, les algorithmes combinatoires et les applications des mathématiques discrètes et algorithmiques, notamment les graphes du Web, la bioinformatique, les réseaux de télécommunication et le traitement de l'information.

Le congrès compte déjà sur la présence d'une superbe brochette d'invités, véritable mélange d'universitaires, d'industriels et de mathématiques pures, appliquées, algorithmiques et discrètes : Valerie King (Université de Victoria), Janos Pach (City College et Institut Courant), Bill Pulleyblank (IBM Research), David Sankoff (Université d'Ottawa), Vera Sos (Académie des sciences de Hongrie), Peter Winkler (Dartmouth) et Xuding Zhu (Université nationale Sun Yat-sen). Pour de plus amples renseignements sur le congrès, passez au http://www.cs.ualberta.ca/»mreza/CANADAM. Ayant déjà vécu en Alberta, je peux affirmer qu'il n'y a pas d'endroit plus magnifique où se retrouver au Canada que Banff.

Nous vous invitons donc à venir nous voir en mai et à participer à ce qui promet d'être le premier d'une longue série de congrès absolument époustouflants. J'espère avoir le bonheur de vous y rencontrer… avec ou sans Stetson!

The Langlands conjecture, in this special case, is known as the Shimura-Taniyama conjecture. It asserts that the generating series

$$f_E(\tau) := \sum_{n=1}^{\infty} a_n e^{2\pi i n\tau},$$

viewed as an analytic function of the variable τ in the complex upper half-plane, is a *modular form* of weight 2 on a specific (explicitly determined, in terms of E) finite-index subgroup $\Gamma \subset SL_2(\mathbb{Z})$. Modularity in this setting means that f_E satisfies the deep periodicity

$$f_E\left(\frac{a\tau + b}{c\tau + d}\right) = (c\tau + d)^2 f_E(\tau),$$

for all matrices

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \in \Gamma,$$

together with certain (equally deep) conditions of moderate growth at the boundary of the quotient $\Gamma\backslash H$.

The proof of the Shimura-Taniyama conjecture was completed in [BCDT] by capitalising on the revolutionary techniques of [W] and [TW] that led to the proof of Fermat's Last Theorem. The Shimura-Taniyama conjecture reveals a pattern satisfied by the σ_p, which, although less easily described than the simple periodicity of quadratic reciprocity, has many of the same desirable consequences for $L(E, s)$. For example, Hecke showed how the modularity of E implies that its L-series has a simple integral representation

$$L(E,s) = (2\pi)^s \Gamma(s)^{-1} \int_o^\infty f_E(iy) y^s \frac{dy}{y},$$

leading to the analytic continuation and functional equation satisfied by $L(E, s)$. These classical topics are recalled, in a treatment that is brief but complete, in the first sections of [C]. Cogdell's contribution then turns to a more general framework for Langlands functoriality, where ρ is now taken to be an n-dimensional representation of $G_F := \mathrm{Gal}(\bar{F}/F)$, for some number field F. In this level of generality, the conjectures are most conveniently expressed by replacing classical modular forms by automorphic forms and representations. The automorphic forms considered in [C] are special kinds of functions on $GL_n(\mathbb{A}_F)$, where $\mathbb{A}_F$ denotes the ring of adèles of F, i.e., the restricted product of all the completions of F relative to their maximal compact subrings. It is a requirement of the definition that the form satisfy suitable growth and invariance properties under right translation by elements in a compact subgroup of $GL_n(\mathbb{A}_F)$, as well as (crucially) being invariant under left translation by the discrete subgroup $GL_n(F) \subset GL_n(\mathbb{A}_F)$. An even more flexible (if at first somewhat daunting to the novice) framework for working with automorphic forms is the theory of *automorphic representations* (typically infinite-dimensional) of the adèlic group $GL_n(\mathbb{A}_F)$ occuring in a suitable space of functions on $GL_n(F)\backslash GL_n(\mathbb{A}_F)$. The sequence of shifts in point of view that make it possible to pass from classical modular forms, first to automorphic forms, and then to automorphic representations, is well motivated and explained in sections 2 and 3 of [C].

To each automorphic representation π of GL_n over F is associated an L-function $L(\pi, s)$. The precise definition of this L-function would take us a bit far afield, but here are its main features. One first shows that any "reasonably nice" (the technical term being "admissible") representation π can be expressed as a restricted tensor product $\otimes_v \pi_v$, taken over all completions F_v of F, where π_v is a representation of the group $GL_n(F_v)$. An important subclass of these "local" representations, referred to as *unramified representations*, are parametrized by conjugacy classes in $GL_n(\mathbb{C})$. For a given π, all but finitely many π_v are unramified in this sense. Hence any automorphic representation gives rise to a collection of conjugacy classes $\sigma_v(\pi)$ in $GL_n(\mathbb{C})$ indexed by the primes v of F (outside a finite set of exceptions). The $\sigma_v(\pi)$ are called the *Langlands parameters* associated to π. The L-function attached to π, denoted $L(\pi, s)$, is now defined in the same way as the L-function of a Galois representation, but with Frobenius elements replaced by the classes $\sigma_v(\pi)$. One of the predictions of the Langlands conjecture is that, for *any* n-dimensional Galois representation ρ, there is an automorphic representation π_ρ of $GL_n(F)$ with $L(\rho, s) = L(\pi_\rho, s)$. For such $\pi = \pi_\rho$, the Langlands parameters $\sigma_v(\pi)$ should therefore display *the same sort* of coherence as that which is satisfied by the Frobenius elements σ_v of a Galois representation.

The category of Galois representations of GF is equipped with the standard panoply of linear algebra constructions (duality, as well tensor, symmetric and alternating products) making it possible to build new representations from old ones. A consequence of functoriality (and this is the way in which functoriality is often exploited in representation theory) is that these constructions should have counterparts on the automorphic side. Such predictions "arising from number theory" are often highly non-trivial, yielding surprising and deep insights into the behaviour of automorphic representations. (The information can also go in the other direction, as in the proof of the Shimura-Taniyama conjecture and Fermat's Last Theorem, or, even more germane to the present review, the recent progress on the Sato-Tate conjecture.)

There are many ways in which n-dimensional ℓ-adic representations can arise in number theory, typically by considering the étale cohomology groups of varieties over number fields. After the Galois representation ρ_E of (1), the most natural example is perhaps the n-th symmetric power of ρ_E. This is an $(n + 1)$-dimensional representation of $G_{\mathbb{Q}}$, denoted

(3) $\mathrm{Sym}^n \rho_E : G_{\mathbb{Q}} \longrightarrow GL_{n+1}(\mathbb{Q}_\ell)$.

The Frobenius elements $\sigma_p^{(n)} := \mathrm{Sym}^n \sigma_p$ associated to this representation have eigenvalues given by

$$\lambda_p^{(i)} := \alpha_p^{n-i}\beta_p^i, \qquad i = 0,1,\ldots,n.$$

The Langlands functoriality conjecture predicts that the representation (3) should, as in the case $n = 1$, be associated to an automorphic representation of $GL_{n+1}(\mathbb{Q})$. This conjecture implies in particular that the L-series

$$L_n(E,s) := L(Sym^n \rho_E, s) = \prod_p \prod_{i=0}^{n} (1 - \lambda_p^{(i)} p^{-s})^{-1}$$

admits a functional equation and an analytic continuation to the entire complex plane.

It was already known from work of Gelbart and Jacquet that the Galois representation $\mathrm{Sym}^2\rho$ is automorphic if ρ is *any* two-dimensional representation of G_F that is itself associated to an automorphic representation of $GL_2(F)$. The breakthrough of Kim and Shahidi is the corresponding statement for the representations $\mathrm{Sym}^3\rho$ [KS] and $\mathrm{Sym}^4\rho$ [Kim].

When combined with the Shimura-Taniyama conjecture, the work of Kim and Shahidi implies that the L-series $L_2(E, s)$, $L_3(E, s)$, and $L_4(E, s)$ admit analytic continuations and functional equations of the standard type. (It also implies, by a technique known as the Rankin-Selberg method, similar analyticity statements for the integers $n \leq 8$, although the L-function $L_n(E, s)$ is not proved to arise from an

automorphic form for n > 4.)

The basic idea for proving automorphy results of this type is first to relate L-series like $L_n(E, s)$ to the constant terms of certain Eisenstein series; the analytic continuation and functional equation satisfied by the Eisenstein series can then be transferred to the constant term. This powerful method for studying L-series was initiated by Langlands and developed further by Shahidi, and it now goes under the name of the Langlands-Shahidi method. A description of the Langlands-Shahidi method and its use in proving the main results of [KS] and [Kim] is one of the goals of the contribution [K].

The Langlands-Shahidi method explained in [K] makes it possible to prove that the L-series $L(\mathrm{Sym}^n\rho, s)$ ($n = 2, 3, 4$), as well as related L-series obtained by twisting $\mathrm{Sym}^n\rho$ by automorphic representations of lower dimension, behave (from the point of view of their functional equations and analytic properties) as if $\mathrm{Sym}^n\rho$ were automorphic. The mechanism for concluding that $\mathrm{Sym}^n\rho_E$ is in fact attached to an automorphic form goes under the rubric of *converse theorems*.

The fundamental work of Hecke (recalled in Section 1 of [C]) shows that the L-series attached to classical cusp forms f on $GL(2)$ have analytic continuations and satisfy functional equations of a standard type as well as being bounded in vertical strips. Let us call an L-series *nice* if it satisfies these properties. Hecke's theory shows that the L-series obtained from the *twists* of f by one-dimensional characters are also nice. (We will not go into the precise definition of "nice", or of twisting, as this would take us too far afield.)

Weil proved a kind of converse to Hecke's statement by showing that if the L-series attached to an admissible representation f of $GL_2(\mathbb{Q})$ and sufficiently many of its twists are nice, then f is in fact automorphic. Converse theorems have been extended to representations of $GL_n(F)$ and are the main topic discussed in [C].

Knowing that the representations in (3) are automorphic, and hence that the L-series $L_n(E, s)$ possess analytic continuations at $s = 1$, has important applications to the analytic number theory of elliptic curves, which are discussed in Ram Murty's contribution [M]. One of the most striking is to the Sato-Tate conjectures, which predicts that (when the elliptic curve E has only the obvious endomorphisms by $\mathbb{Z}$) the complex numbers

$$\alpha_p / \sqrt{p}$$

attached to E are distributed on the unit circle according to a specific density function, the *Sato-Tate distribution*. More precisely, the arguments of α_p should be equidistributed on the interval $[0, \pi]$ according to the density

$$\frac{2}{\pi}\sin^2\theta d\theta.$$

The first section of [M] explains why the analyticity and non-vanishing of $L_n(E, s)$ at $s = 1$ (for all n) implies the Sato-Tate conjecture for E.

The Sato-Tate conjecture (for a fixed elliptic curve E) would follow from a proof of Langlands Functoriality for *all* $\mathrm{Sym}^n\rho_E$, yielding the analyticity of $L_n(E, s)$ for all n. The result of Kim and Shahidi carries out this program for $n = 3$ and 4, and can be viewed as a significant step towards understanding the Sato-Tate conjecture.

A few months ago, the preprint [Ta], completing the program initiated in [CHT] and [HSBT], succeeded in showing (for a large class of elliptic curves E, essentially those having non-integral j-invariant) the analytic continuation of the L-series $L_n(E, s)$ for *all* n, thereby proving the Sato-Tate conjecture for these E! The proof adapts the methods of [T] and [TW] to the setting of the representations $\mathrm{Sym}^n\rho_E$. The final result is less precise than the results of Kim and Shahidi for $n = 3$ and 4, since it only establishes *potential modularity* of the representations $\mathrm{Sym}^n\rho_E$: namely, that after restricting $\mathrm{Sym}^n\rho_E$ to the Galois group of some totally real field F (which could depend *a priori* on n) the corresponding L-series is attached to an automorphic form on $GL_n(F)$. However, even this cruder form of Langlands functoriality is enough to establish the Sato-Tate conjecture, and represents another spectacular success to emerge from the circle of ideas surrounding the "Langlands program".

In conclusion, [CKM] will be valuable both as a reference or textbook for researchers and students interested in a vibrant area of modern mathematics at the intersection of representation theory and number theory which has witnessed a tremendous amount of recent progress.

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CALL FOR NOMINATIONS / APPEL DE MISES EN CANDIDATURE

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

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

Prix Coxeter-James Prize Lectureship 2008

The Coxeter-James Prize Lectureship recognizes young mathematicians who have made outstanding contributions to mathematical research. The selected candidate will deliver the prize lecture at the Winter Meeting.

The recipient shall be a member of the Canadian mathematical community. Nominations may be made up to ten years from the candidate's Ph.D: researchers having their PhD degrees conferred in 1997 or later will be eligible for nomination in 2007 for the 2008 Coxeter-James prize. A nomination can be updated and will remain active for a second year unless the original nomination is made in the tenth year from the candidate's Ph.D.

Le prix Coxeter-James rend hommage aux jeunes mathématiciens qui se sont distingués par l'excellence de leur contribution à la recherche mathématique. La personne choisie prononcera sa conférence à la Réunion d'hiver.

Cette personne doit être membre de la communauté mathématique canadienne. Les candidats sont admissibles jusqu'à dix ans après l'obtention de leur doctorat : ceux qui ont obtenu leur doctorat en 1997 ou après seront admissibles en 2007 pour le prix Coxeter-James 2008. Toute mise en candidature est modifiable et demeurera active l'année suivante, à moins que la mise en candidature originale ait été faite la 10e année suivant l'obtention du doctorat.

Prix Jeffery-Williams Prize Lectureship 2009

The Jeffery-Williams Prize Lectureship recognizes mathematicians who have made outstanding contributions to mathematical research. The prize lecture will be delivered at the Summer Meeting. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for three years.

Le prix Jeffery-Williams rend hommage aux mathématiciens ayant fait une contribution exceptionnelle à la recherche mathématique. La personne choisie prononcera sa conférence à la Réunion d'été. Cette personne doit être membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant trois ans.

Prix Krieger-Nelson Prize Lectureship 2009

The Krieger-Nelson Prize Lectureship recognizes outstanding research by a female mathematician. The prize lecture will be delivered at the Summer Meeting. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for two years.

Le prix Krieger-Nelson rend hommage aux mathématiciennes qui se sont distinguées par l'excellence de leur contribution à la recherche mathématique. La lauréate prononcera sa conférence à la Réunion d'été. La lauréate doit être membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant deux ans.

The deadline for nominations is June 30, 2007. Letters of nomination should be sent to the address below.
La date limite de mises en candidature est le 30 juin 2007. Veuillez faire parvenir les dossiers de candidature à l'adresse ci-dessous.

Nominators should ask at least three referees to submit letters directly to the Chair of the CMS Research Committee by September 30, 2007. Some arms length referees are strongly encouraged. Nomination letters should list the chosen referees, and should include a recent curriculum vitae for the nominee, if available.

Les proposants doivent faire parvenir trois lettres de référence au président du Comité de recherche de la SMC au plus tard le 30 septembre 2007. Nous vous incitons fortement à fournir des références indépendantes. Le dossier de candidature doit comprendre le nom des personnes données à titre de référence ainsi qu'un curriculum vitae récent du candidat ou de la candidate, dans la mesure du possible.

J.F. Jardine, Chair / Président
CMS Research Committee / Comité de recherches de la SMC
Department of Mathematics
The University of Western Ontario
London, Ontario N6A 5B7 Canada

The 2007 Krieger-Nelson and Jeffrey-Williams Prizes will be presented at the CMS-MITACS Joint Conference 2007 in Winnipeg, Manitoba, May 31 to June 3.
Les prix Krieger-Nelson et Jeffrey-Williams 2007 seront présentés à la Congrès conjoint MITACS-SMC 2007 à Winnipeg (Manitoba) du 31 mai au 3 juin.

Prix Adrien-Pouliot Prize Lectureship 2007

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

Les candidatures doivent nous être transmises via le « Formulaire de mise en candidature » disponible au site Web de la SMC : **www.cms.math.ca/Prix/info/ap**. Pour garantir l'uniformité du processus de sélection, veuillez suivre les instructions à la lettre. Toute documentation excédant les limites prescrites ne sera pas considérée par le comité de sélection.

Il est possible de renouveler une mise en candidature présentée l'an dernier, pourvu que l'on en manifeste le désir avant la date limite. Dans ce cas, le présentateur n'a qu'à soumettre des documents de mise à jour puisque le dossier original a été conservé. Les mises en candidature doivent parvenir au bureau de la SMC avant le **30 avril 2007**. Veuillez faire parvenir vos mises en candidature en six exemplaires à l'adresse ci-dessous :

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

Nominations must be submitted using the Nomination Form available from the CMS Web site at: **www.cms.math.ca/Prizes/info/ap**. To assure uniformity in the selection process, please follow the instructions precisely. Documentation exceeding the prescribed limits will not be considered by the Selection Committee.

Individuals who made a nomination in 2006 can renew this nomination by simply indicating their wish to do so by the deadline date. Only materials updating the 2006 Nomination need be provided as the original has been retained. Nominations must be received by the CMS Office no later **April 30, 2007**. Please send six copies of each nomination to the address given below.

The Adrien Pouliot Award / Le Prix Adrien-Pouliot
Canadian Mathematical Society / Société mathématique du Canada
577 King Edward
Ottawa, Ontario K1N 6N5

The 2007 Adrien-Pouliot Award will be presented at the CMS Winter 2007 Meeting in London, ON, December 8 to 10.
Le prix Adrien-Pouliot seront présentés à la Réunion d'hiver 2007 de la SMC à London (Ontario), du 8 au 10 décembre.

CMS Prize Lecturships and Awards Programmes - Prix et bourses de la SMC

The most up-to-date information concerning all CMS Prize Lectureships & Awards programmes, including complete lists of recipients, can be found at: www.cms.math.ca/Prizes/

Vous trouverez l'information la plus récente sur les prix et bourses de la SMC, y compris les listes de lauréats, sur le site Web suivant : www.smc.math.ca/Prizes/

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

MAY 2007 MAY

7-9 "Adaptive Dynamics in Theory and Practice", Fields Institute Workshop, University of Ottawa
www.mathstat.uottawa.ca/%7Efluts037/FIELDS/fieldsworkshop.html

14-18 "Stacks in geometry and topology", Fields Institute Thematic Program; workshop

18-20 The 2007 Midwest Geometry Conference (MGC 2007) (University of Iowa, Iowa City, IA) www.emis.de/journals/SIGMA/

20-24 The CAIMS Annual Meeting (Banff Conference Centre)

26-30 "Homotopy theory of schemes", Fields Institute Thematic Program; workshop

21-23 Applications of Analysis to Mathematical Biology (Duke University, Durham, NC)
www.math.duke.edu/conference/AAM07

22-26 Extremal problems in complex and real analysis (Peoples Friendship University of Russia, Moscow,Russia)
www.albany.edu/~pb6916/, stessin@math.albany.edu

28-31 Canadian Discrete and Algorithmic Mathematics Conference (CanaDAM) (Banff Conference Center)

29-Jun1 The Fourth International Conference on Mathematical Biology (Wuyishan City, Fujian, P.R. China)
www.csmb.org.cn/

30-Jun2 Fifth International Conference of Dynamic Systems and Applications (Morehouse College, Atlanta, GA)
www.dynamicpublishers.com/icdsa5.htm, icdsa5@yahoo.com

31-Jun3 CMS-MITACS Joint Conference 2007 (University of Manitoba) Delta Hotel, Host, Winnipeg, Manitoba
www.cms.math.ca/events, meetings@cms.math.ca

JUNE 2007 JUIN

18-23 Combinatorics and Optimization 40th Anniversary Conference (University of Waterloo, Waterloo, ON)
www.math.uwaterloo.ca/Cand_Dept/Conference/40thConference.shtml

24-Jul1 45th International Symposium on Functional Equations (Bielsko-Biala, Poland)
romanger@us.edu.pl, knikodem@ath.bielsko.pl

JULY 2007 JUILLET

2-6 Design Theory of Alex Rosa, a meeting in celebration of Alex Rosa's 70th birthday (Bratislava, Slovakia)
www.dumn.edu/~dfroncek/alex/index.htm

4-8 International Conference on Nonlinear Operators, Differential Equations and Applications (ICNODEA 2007) (Bolyai University, Cluj-Napoca, Romania)
www.dumn.edu/~dfroncek/alex/index.htm

10-14 The Twenty-Second IEEE Symposium on Logic in Computer Science (LICS 2007) (Wroclaw, Poland)
www.dumn.edu/~dfroncek/alex/index.htm

15-17 Seminar on Stochastic Processes (Fields Institute, Toronto)
www.fields.utoronto.ca/programs/scientific/06-07/ssp2007/

16-20 6th International Congress on Industrial and Applied Mathematics (Zurich, Switzerland)
www.iciam07.ch

16-22 The 8th International Conference on Fixed Point Theory and its Applications (Ching Mai Univesity, Thailand)
www.math.science.cmu.ac.th/ICFPTA2007/

19-23 Motives and Algebraic Cycles, A Conference Dedicated to the Mathematical Heritage of Spencer J. Bloch (Fields Institute, Toronto) Co-organized by the Clay Mathematics Institute
www.fields.utoronto.ca/programs/scientific/06-07/homotopy/

26-30 Workshop on Homotopy Theory of Schemes (Fields Institute, Toronto)
www.fields.utoronto.ca/programs/scientific/06-07/homotopy/

27-29 4th Joint meeting of the Canadian Society for History and Philosophy of Mathematics/Société canadienne d'histoire et de philosophie des mathématiques and the British Society for the History of Mathematics (Concordia University) www.cshpm.org

31-Aug 3 First Joint International Meeting between the AMS and the Polish Mathematical Society (Warsaw, Poland)
www.ams.org/amsmtgs/internmtgs.html

SEPTEMBER 2007 SEPTEMBRE

17-21 "Free Probability, Random Matrices, and Planar Algebras" (Fields Institute workshop)
www.fields.utoronto.ca/programs/scientific/07-08/operator_algebras/

OCTOBER 2007 OCTOBRE

29-Nov 2 "Von Neumann Algebras" (Fields Institute workshop)
www.fields.utoronto.ca/programs/scientific/07-08/operator_algebras/

EMPLOYMENT OPPORTUNITY: Senior Instructor, University of Victoria, Department of Mathematics and Statistics

The Department of Mathematics and Statistics at the University of Victoria invites applications for a Senior Instructor position to commence July 1, 2007, or as soon as possible after that date. Applicants should have a Ph.D. in Mathematics or a related discipline (at least a Master's degree is required), a strong commitment to teaching, and the ability to teach all Mathematics and Statistics courses at the first and second year levels including calculus, differential equations, linear algebra, finite and discrete mathematics, and statistics. The initial appointment is for three years, with a normal expectation of subsequent 4-year re-appointments. The successful applicant will be expected to teach eight one-term courses per year, to co-ordinate courses, to engage in curriculum development and teaching scholarship, and service to the University and discipline.

Information about the department, including descriptions of courses offered, can be found at its website: http://www.math.uvic.ca/

Applicants should submit a curriculum vitae and teaching dossier (or equivalent documentation) that outlines their teaching experience, philosophy and effectiveness. Applicants should arrange for three letters of reference to be sent. Applications and letters of reference should be sent to:

Dr. Gary MacGillivray, Chair

Department of Mathematics and Statistics
University of Victoria
PO Box 3045 STN CSC
Victoria BC V8W 3P4
Canada

Telephone: (250) 721-7436
Fax: (250) 721-8962
E-mail: instcomp@math.uvic.ca

The CLOSING DATE for applications is April 10, 2007

The University of Victoria is an equity employer and encourages applications from women, persons with disabilities, visible minorities, Aboriginal Peoples, people of all sexual orientations and genders, and others who may contribute to the further diversification of the University.

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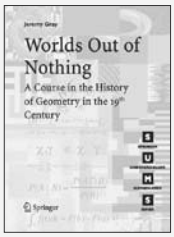

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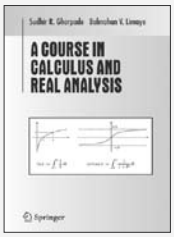

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