Volume 40   Number 2   2013

The Australian Mathematical Society

Gazette

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The *Gazette* publishes items of the following types:

- Reviews of books, particularly by Australian authors, or books of wide interest
- Classroom notes on presenting mathematics in an elegant way
- Items relevant to mathematics education
- Letters on relevant topical issues
- Information on conferences, particularly those held in Australasia and the region
- Information on recent major mathematical achievements
- Reports on the business and activities of the Society
- Staff changes and visitors in mathematics departments
- News of members of the Australian Mathematical Society

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Notes for contributors

Please send contributions to gazette@austms.org.au. Submissions should be fairly short, easy to read and of interest to a wide range of readers.

Please typeset technical articles using $\LaTeX 2_\varepsilon$ or variants. In exceptional cases other editable electronic formats such as plain text or Word may be accepted. Please do not use definitions in your TEX files, as they may conflict with our style files. If you find such definitions convenient, please use a text editor to reinstate the standard commands before sending your submission.

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More information can be obtained from the *Gazette* website.

Deadlines for submissions to 40(3), 40(4) and 40(5) of the *Gazette* are 1 June, 1 August and 1 October 2013.

Volume 40 Number 2 2013

Editorial

Welcome to another issue of the *Gazette*; this issue contains a number articles held over from the previous issue due to lack of space.

The health of the mathematical sciences in Australia should be of concern to all us. Some of our problems are the declining qualifications of secondary mathematics teachers, and the poor public perception of the relevance of mathematics. Discussion about the way ahead continues, with the Decadal Plan in preparation and proposals for a national mathematics research centre. Reports from the President of the Society, Director of AMSI and Chair of NCMS all elaborate on these issues.

One way of engaging with the wider mathematical community is to serve on the Council of the Society. Several vacancies exist for the session commencing after the Annual General Meeting early in October. Nominations close on June 21; further details can be found in the AustMS report.

Other regular features include several book reviews, the puzzle corner and news from local correspondents. These are accompanied by conference reports and two obituaries, of Brian Day and Alexei Pokrovskii.

I take this opportunity to advertise the Society's Lift-Off Fellowship scheme. This is designed to help recent PhD graduates in Mathematics and Statistics jumpstart their careers by providing them short-term support financial support during the period between the submission of their PhD thesis and their first postdoctoral position. Fellowships can be used for living expenses, travel, participation in conferences and to fund visits of collaborators. This issue contains a further three reports from Lift-off Fellows on their work. The rules and application forms for the Lift-Off Fellowships can be found at http://www.austms.org.au/Lift-Off+Fellowship+information.

Finally, congratulations to Ben Andrews and Andrew Hassell on their election as Fellows of the Australian Academy of Science. A short report records their citations.

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David Yost holds a BSc from Melbourne University, an MSc from ANU and a PhD from Edinburgh. He has previously worked at La Trobe University, the Australian National University, the Free University of Berlin, the University of Milan, the Polytechnic University of Milan, the University of Extremadura and King Saud University, and been a long term visitor at the University of Lyon and Chulalongkorn University. He has been the recipient of a Queen Elizabeth II Fellowship, a Humboldt Fellowship and the Lester R Ford Award (the latter jointly with the other editor). His random walk through mathematics has taken him from C^*-algebras and Banach spaces to combinatorial geometry, optimization and polyhedra. He has been at the University of Ballarat since 2003.

President's Column

Peter Forrester*

As I begin to write this column, a media release has just been circulated announcing the latest Australian scientists to be elected to the Australian Academy of Science. AustMS is proud to see that two of our members, Ben Andrews and Andrew Hassell, both from the ANU, are among this list of very distinguished new Fellows — our heartiest congratulations go out to Ben and Andrew for this recognition. This comes at a time when the Australian Academy of Science is prominent in the concerns of AustMS through its overseeing of a Decadal Plan for the Mathematical Sciences. I mentioned the Decadal Plan briefly in my previous President's Column; its importance warrants it being my main theme this time round. A past AustMS President, Nalini Joshi, in her capacity as Chair of the National Committee for Mathematical Sciences, began the process in earnest early last year, by undertaking a fundraising drive, forming a steering committee, and generally giving airplay to this very important happening — recall for example Nalini's *Gazette* article published in July last year.

A number of AustMS members have key roles in the subcommittees formed by the steering committee. For example, new FAA Andrew Hassell is a co-chair of sub-committee three relating to research in the mathematical sciences in the university sector, and I'm chairing sub-committee six relating to research centres. Also, AustMS secretary Peter Stacey has taken on the role of a project officer, which despite its modest title is very important in co-ordinating submissions. Already Peter has convened meetings in the various capital cities to collect together opinions offered at Decadal Plan presentations he gave, in partnership with a local presenter, from the attendees. As mentioned in my previous column, written submissions can be made through the appropriate website, with the closing date now the end of April.

One of the common threads to emerge from Peter's summary of the meetings has been the recognition of the need to redouble our efforts to work with the various interested parties in the mathematical sciences in a progressive way. At the university level, this relates to the crucial issue of service teaching, which in turn relates to the reality — already commonplace in statistics — that applied mathematicians can often have appointments outside of a mathematical sciences department. At the Australian Council of Heads of Mathematical Sciences annual meeting earlier this year, Cristina Varsavsky, the associate Dean (Education) for Science at Monash spoke on the issue of service teaching. One take home point was the challenge, or indeed need, to have hard data on why service teaching is best carried out within the mathematical sciences department rather than the department requiring that their students have this knowledge. On the issue

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of leveraging extra government funding, the reality that we need to go beyond convincing the government itself and also make the case to industry and business, was noted on a number of occasions. Although the set up of AustMS is not optimised for this purpose, we are very fortunate that AMSI has appointed several board members well known and respected in industry and business.

A number of other countries have recently produced reports relating to the future of their mathematical sciences. Two examples are Canada and the US. In the US, the National Academy of Sciences commissioned a report 'The Mathematical Sciences in 2025'. There an increasingly important role is envisaged for the mathematical sciences in interdisciplinary research, to the extent that it is recommended the education of future generations of mathematical scientists should be re-assessed in this light. In particular, a call was made to increase the number of mathematical scientists trained to have knowledge across a broad range of disciplines, an understanding of the role of mathematics in broad applications, to have some experience with computation, and to communicate well with researchers in other disciplines. On the national front, late last year saw the release of the National Research Investment Plan. In my role on sub-committee six relating to research centres, I was most interested to read on the topic of National Research Infrastructure that the best value for money is obtained when infrastructure encourages increased collaboration among Australian researchers, including business researchers, and provides facilities that attract increased collaboration and support from international researchers and investors.

Peter Forrester received his Doctorate from the Australian National University in 1985, and held a postdoctoral position at Stony Brook before joining La Trobe University as a lecturer in 1987. In 1994 he was awarded a senior research fellowship by the ARC, which he took up at The University of Melbourne. Peter's research interests are broadly in the area of mathematical physics, and more particularly in random matrix theory and related topics in statistical mechanics. This research and its applications motivated the writing of a large monograph 'log-gases and random matrices' (PUP, Princeton) which took place over a fifteen-year period. His research has been recognised by the award of the Medal of the Australian Mathematical Society in 1993, and election to the Australian Academy of Science in 2004, in addition to several ARC personal fellowships.

Puzzle Corner

Ivan Guo*

Welcome to the Australian Mathematical Society *Gazette*'s Puzzle Corner number 32. Each puzzle corner includes a handful of fun, yet intriguing, puzzles for adventurous readers to try. They cover a range of difficulties, come from a variety of topics, and require a minimum of mathematical prerequisites for their solution. Should you happen to be ingenious enough to solve one of them, then you should send your solution to us.

For each puzzle corner, the reader with the best submission will receive a book voucher to the value of $50, not to mention fame, glory and unlimited bragging rights! Entries are judged on the following criteria, in decreasing order of importance: accuracy, elegance, difficulty, and the number of correct solutions submitted. Please note that the judge's decision — that is, my decision — is absolutely final. Please email solutions to ivanguo1986@gmail.com or send paper entries to: Gazette of the Australian Mathematical Society, School of Science, Information Technology & Engineering, University of Ballarat, PO Box 663, Ballarat, Vic. 3353, Australia.

The deadline for submission of solutions for Puzzle Corner 32 is 1 July 2013. The solutions to Puzzle Corner 32 will appear in Puzzle Corner 34 in the September 2013 issue of the *Gazette*.

Notice: If you have heard of, read, or created any interesting mathematical puzzles that you feel are worthy of being included in the Puzzle Corner, I would love to hear from you! They don't have to be difficult or sophisticated. Your submissions may very well be featured in a future Puzzle Corner, testing the wits of other avid readers.

Telescoping product

Let n be an integer greater than 1. Simplify

$$\frac{2^3-1}{2^3+1}\times\frac{3^3-1}{3^3+1}\times\cdots\times\frac{n^3-1}{n^3+1}.$$

Tangent intersections

Let Γ_1 and Γ_2 be two non-overlapping circles with centres O_1 and O_2 respectively. From O_1, draw the two tangents to Γ_2 and let them intersect Γ_1 at points A and B.

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This puzzle corner is also featured on the Mathematics of Planet Earth Australia website
http://mathsofplanetearth.org.au/

Similarly, from O_2, draw the two tangents to Γ_1 and let them intersect Γ_2 points by C and D.

Prove that $AB = CD$.

Colour coordination

Submitted by Joe Kupka

I need to hang 20 garments on a clothes line. Each garment requires two pegs. I have 20 green and 20 red pegs. I choose pegs at random. On average, how many garments will have pegs of the same colour?

Team tactics 2

In a game show, there are three girls, each wearing a blue or a red hat. Each girl can only see the hats of the other two but not her own. Without any communication between themselves, each girl has to choose a real number and whisper it to the host. At the end, the host will add up the numbers chosen by girls wearing red hats, then subtract the numbers chosen by girls wearing blue hats. The girls win if the final answer is positive.

Before the show, the girls try to devise a strategy to maximise their probability of winning.

(i) What is the maximum probability of winning?
(ii) If the girls were only allowed to choose from $\{-1, 0, 1\}$, what is the maximum probability of winning?

Bonus: If there are seven girls instead of three, and each girl can see the hats of the other six but not her own, how do the answers change?

A sequence of sequences

Let $S_1, S_2, \ldots$ be finite sequences of positive integers defined in the following way. Set $S_1 = (1)$. For $n > 1$, if $S_{n-1} = (x_1, \ldots, x_m)$ then

$$S_n = (1, 2, \ldots, x_1, 1, 2, \ldots, x_2, \ldots, 1, 2, \ldots, x_m, n).$$

For example, the next few sequences are $S_2 = (1, 2)$, $S_3 = (1, 1, 2, 3)$ and $S_4 = (1, 1, 1, 2, 1, 2, 3, 4)$.

Prove that in the sequence S_n where $n > 1$, the kth term from the left is 1 if and only if the kth term from the right is not 1. (*Hint:* Pascal's triangle.)

Solutions to Puzzle Corner 30

Many thanks to everyone who submitted. The \$50 book voucher for the best submission to Puzzle Corner 30 is awarded to Dave Johnson. Congratulations!

Peculiar pace

Jodie jogged for 25 minutes. In any 10-minute period, her average speed was 18 kilometres per hour. How far did she run?

Solution by Darren O'Shaughnessy: Divide the 25 minutes up into 5 sessions of 5 minutes. Since Jodie jogged exactly 6 km in the first 4 sessions and no more than 3 km in the last session, the answer has to be between 6 km and 9 km. If Jodie is a robot, then any value between 6 and 9 is possible. For example, to achieve $(6+x)$ km, where $0 \leq x \leq 3$, she could jog at $12x$ km/h during sessions 1, 3 and 5, and jog at $(36 - 12x)$ km/h during sessions 2 and 4.

However, assuming Jodie is human, she would likely be constrained by physiological limits. The record speed over five minutes by a woman is approximately 22.2 km/h. If Jodie could manage that three times in 25 minutes, the upper limit would be $3 \times 22.2/12 + 2 \times (36 - 22.2)/12 = 7.85$ km. But it is likely to be substantially less due to the cumulative fatigue from three bursts of world-record pace.

Comment by Joe Kupka: If the '10-minute period' does not have to be a connected interval, then the answer would be 7.5 km.

Rolling roadblocks

There are 10 cars on an infinitely long, single-lane, one-way road, all travelling at different speeds. When any car catches up to a slower car, it slows down and stays just behind the slower car without overtaking. Eventually, the cars form a number of separate blocks. On average, how many blocks do you expect to see?

Solution by Pratik Poddar: We will solve the general problem of n cars. Car i (ith car from the front) will be at the start of a block if and only if it is slower than all of the cars in front. Out of the first i cars, each of them has equal chance of being the slowest. Hence the chance of car i being the slowest of the first i cars is $\frac{1}{i}$.

Now the number of blocks formed is also the number of cars being at the start of a block. By linearity of expectations,

$$\begin{aligned}\text{Expected number of blocks} &= \sum_{i=1}^{n} P(\text{Car } i \text{ is at the start of a block}) \\ &= \sum_{i=1}^{n} \frac{1}{i}.\end{aligned}$$

So the required answer is $\frac{1}{1} + \frac{1}{2} + \cdots + \frac{1}{10}$.

Polynomial parity

(i) *Let P and Q be complex polynomials with no common factors. Suppose the rational function P/Q is an even function. Prove that P and Q are both even functions.*

(ii) *Let P, Q and R be complex polynomials. Suppose PQ, PR and QR are all even functions. Prove that either P, Q and R are all even functions, or they are all odd functions.*

Solution by Dave Johnson:

(i) In P, we may separate the odd and even degree terms by writing $P(z) = A(z^2)z + B(z^2)$ for polynomials A and B. Similarly write $Q(z) = C(z^2)z + D(z^2)$. Using the shorthand $A = A(z^2)$ etc., we have

$$\begin{aligned} & P(z)/Q(z) = P(-z)/Q(-z) \\ \Longrightarrow \quad & (Az+B)(-Cz+D) = (-Az+B)(Cz+D) \\ \Longrightarrow \quad & AD - BC = -AD + BC \\ \Longrightarrow \quad & AD = BC. \end{aligned}$$

Thus

$$DP = ADz + BD = BCz + BD = BQ.$$

Since P and Q have no common factors, the polynomial $Q(z)$ must be a factor of $D(z^2)$. But from $Q(z) = C(z^2)z + D(z^2)$, the degree of $Q(z)$ must be at least as big as the degree of $D(z^2)$. Hence $Q(z)$ and $D(z^2)$ must have equal degrees and $Q(z) = kD(z^2)$ for some $k \in \mathbb{C}$. Therefore Q is an even function. Since P/Q is even, it follows immediately that P is an even function as well.

(ii) Using the notation from part (i), we have

$$\begin{aligned} & P(z)Q(z) = P(-z)Q(-z) \\ \Longrightarrow \quad & (Az+B)(Cz+D) = (-Az+B)(-Cz+D) \\ \Longrightarrow \quad & AD + BC = -AD - BC \\ \Longrightarrow \quad & AD = -BC. \end{aligned}$$

Thus

$$D(z^2)P(z) = ADz + BD = -BCz + BD = B(z^2)Q(-z).$$

If we write $R(z) = E(z^2)z + F(z^2)$, then by the same argument,

$$F(z^2)Q(z) = D(z^2)R(-z), \qquad B(z^2)R(z) = F(z^2)P(-z).$$

Hence

$$\begin{aligned} F(z^2)D(z^2)P(z) &= F(z^2)B(z^2)Q(-z) \\ &= B(z^2)D(z^2)R(z) \\ &= F(z^2)D(z^2)P(-z). \end{aligned}$$

Now there are three cases. Keep in mind that PQ, QR and RP are all even functions.

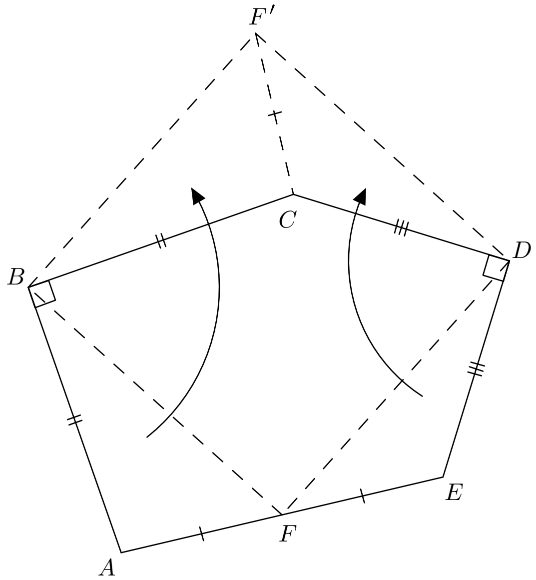
- If $D = 0$, then $Q(z) = C(z^2)z + D(z^2) = C(z^2)z$ is an odd function. Thus P and R are also odd functions.
- If $F = 0$, then $R(z) = E(z^2)z + F(z^2) = E(z^2)z$ is an odd function. Thus P and Q are also odd functions.
- Finally, if F and D are both non-zero, then $P(z) = P(-z)$ must be an even function. Thus Q and R must be even functions as well.

Squaring a pentagon

Let $ABCDE$ be a pentagon with $AB = BC$, $CD = DE$ and $\angle B = \angle D = 90°$. Can you cut the pentagon into three pieces and then rearrange them to form a square?

Solution by Jensen Lai: Let F be the midpoint of AE. Cut along lines BF and DF to form three pieces.

Since $AB = CB$, we can rotate $\triangle ABF$ about B until A coincides with C. Similarly, since $ED = CD$, we can rotate $\triangle DEF$ about D until E also coincides with C. Since angles B and D are right angles, angles A, C and E must sum to 360°. Hence after the two rotations, the line AF should coincide with the line EF. Furthermore, since $AF = EF$, the corners of both rotated triangles will meet at F'.



Now $\angle F'DF = \angle CDF + \angle F'DC = \angle CDF + \angle FDE = 90°$. Similarly $\angle F'BF = 90°$. Finally, since $DF = DF'$ and $BF = BF'$, the quadrilateral $BFDF'$ has to be a square.

Team tactics

In a game show, a team of n girls is standing in a circle. When the game starts, either a blue hat or a red hat is placed on the head of each girl. Due to the set-up of the stage, each girl can only see the hats of the two adjacent girls, but not her own hat nor the hat of anyone else. Without any communication, the girls have to simultaneously guess the colour of their own hats. The team wins if and only if everyone guesses correctly.

Before the show, the girls try to devise a strategy to maximise their probability of winning. What is the maximum probability of winning if

(i) $n = 3$?
(ii) $n = 4$?
(iii) $n = 5$?

Solution by Ross Atkins (problem submitter): Label the girls A, B, C, etc. going around the circle.

(i) For $n = 3$, use the following strategy:
  - If the two adjacent hats are the same, guess blue;
  - If the two adjacent hats are different, guess red.

  The following colour combinations will result in a win

$$BBB, \quad BRR, \quad RBR, \quad RRB.$$

  This amounts to $4/2^3 = 50\%$ chance of winning.
  Since regardless of the strategy, girl A only has a 50% chance of guessing correctly. Therefore, the team cannot do better than 50%.

(ii) For $n = 4$, use the following strategy:
  - A and B guess each other's hat colours;
  - C and D guess each other's hat colours;

  The following colour combinations will result in a win

$$BBBB, \quad BBRR, \quad RRBB, \quad RRRR.$$

  This amounts to $4/2^4 = 25\%$ chance of winning.
  Both girls A and C will have to base their guesses on the same available information: the hat colours of girls B and D. Also, since they cannot see each other, their chance of success are independent. Now each of A and C only has a 50% chance of guessing correctly. Therefore the team cannot do better than 25%.

(iii) For $n = 5$, use the following strategy:
  - If the two adjacent hats are the same, guess the opposite colour;
  - If the two adjacent hats are different, guess Red.

  The following colour combinations will result in a win

$$RBRBR, \quad BRBRR, \quad RBRRB, \quad BRRBR, \quad RRBRB.$$

  This amounts to $5/2^5 = 15.625\%$ chance of winning.

To show that the girls cannot do better, we argue by contradiction. Assume that there is a strategy which results in six or more different winning colour combinations out of 32. Consider five of these combinations $c_1, \ldots, c_5$.
Take a pair of girls which are not adjacent, say (A, C). There are four possible colour pairs for (A, C), so there must be two combinations containing the same colours for (A, C). Since girl B must guess based solely on the hat colours of A and C, the hat colour of B is forced. So there exist two combinations containing the same colours for the triple (A, B, C). The same can be said about the triples $(B, C, D), (C, D, E), (D, E, A)$ and (E, A, B).
Consider a graph with the combinations $c_1, \ldots, c_5$ as vertices. For each of the five triples $(A, B, C), (B, C, D), \ldots, (E, A, B)$, place an edge between two combinations if they have the same colour for that triple. By the earlier argument, at least one edge of each type must be present. Now there are a few useful properties.

1. By the earlier argument, *there is at least one edge of each type and at least five edges in total.*
2. *No two combinations can agree on four of the five colours.* Otherwise the last colour is forced by the neighbours and the two combinations are identical.
3. *There cannot be more than one edge between two combinations.* Otherwise the two combinations will be agreeing on at least four colours, violating rule 2.
4. *The combination connected to the edge (A, B, C) cannot connect to the edge (B, C, D).* For example, if we have

$$c_1 \overset{(A,B,C)}{\longleftrightarrow} c_2 \overset{(B,C,D)}{\longleftrightarrow} c_3,$$

   it follows from rule 2 that the colour of E in both c_1 and c_3 must be opposite to c_2. Hence c_1 and c_3 have the same colours for B, C and E. But then the colours of A and D are forced by their neighbours and c_1 and c_3 are actually identical. Note that this rule may be applied to other triples too, up to cyclic permutations.

From rules 1, 3 and 4, it is clear that each combination is connected to exactly two other combinations, forming a cycle. The graph must be, up to the relabelling of combinations,

$$c_1 \overset{(A,B,C)}{\longleftrightarrow} c_3 \overset{(C,D,E)}{\longleftrightarrow} c_5 \overset{(E,A,B)}{\longleftrightarrow} c_2 \overset{(B,C,D)}{\longleftrightarrow} c_4 \overset{(D,E,A)}{\longleftrightarrow} c_1.$$

Now if there is a 6th winning combination c_6, we may apply the same arguments to c_1, c_2, c_3, c_4, c_6. So c_6 is forced to take the place of c_5 in the graph. By the definition of the edges, we see that c_6 must be identical to c_5, which is a contradiction.
Therefore there are at most five winning combinations out of 32, and the team cannot do better than $5/32 = 15.625\%$.

Note: We did not explicitly investigate randomised strategies in the solution. The reasoning is as follows: In this problem, the winning probability of any randomised strategy can be written as a weighted sum of the winning probabilities of deterministic strategies. So in order to maximise the winning probability, it suffices to only check the deterministic strategies.

Furthermore, the girls may not be allowed access to any randomisation devices (coins, dice, etc.) during the game show anyway!

Mathematics of Planet Earth 2013 AUSTRALIA

Ivan is a PhD student in the School of Mathematics and Statistics at The University of Sydney. His current research involves a mixture of multi-person game theory and option pricing. Ivan spends much of his spare time playing with puzzles of all flavours, as well as Olympiad Mathematics.

Australian Academy of Science Fellows

Twenty leading scientists were honoured on 27 March 2013 by being elected as Fellows of the Australian Academy of Science. Amongst them were two mathematicians, Ben Andrews and Andrew Hassell, both at the Mathematical Sciences Institute of the Australian National University. The new Fellows will be admitted to the Australian Academy of Science and present summaries of the work for which they have been honoured at the Academy's annual three-day celebration, Science at the Shine Dome, on 29 May in Canberra.

Andrew Hassell (left) and Ben Andrews (right)

Dr Benjamin Hardwick Andrews FAA FAustMS

Ben holds a BSc and a PhD from the Australian National University, the latter under the supervision of Gerhard Huisken. He was awarded the Medal of the Australian Mathematical Society in 2003. He is now a Senior Fellow at ANU.

Ben Andrews is a leading international researcher in differential geometry and related partial differential equations and is particularly famous for his work in geometric evolutions. Recently resolving one of the most celebrated open problems in mathematics, the fundamental gap conjecture for the eigenvalues of the Laplacian, and his 1999 resolution of Firey's conjecture on the shape of rolling stone are among his many achievements.

Benjamin's research successes have been recognised by many awards, including a prestigious invited lecture in the geometry section of the International Congress of Mathematicians in 2002.

Professor Andrew Hassell FAA FAustMS

Andrew received a Bachelor's Degree from the Australian National University, and PhD from the Massachusetts Institute of Technology under the supervision of Richard Melrose. He was awarded the Medal of the Australian Mathematical Society in 2003. He is currently a Future Fellow at ANU.

A leading Australian mathematical analyst, Andrew Hassell specialises in the spectral theory of partial differential equations and harmonic analysis of manifolds. Andrew has made significant contributions to mathematics in the areas of quantum ergodicity and quantum chaos, analysis on asymptotically conic spaces, time-dependent Schrodinger equations and Strichartz estimates, scattering theory, spectral invariants and numerical analysis. He has aroused considerable international interest by exhibiting examples of planar domains on which the billiard flow is ergodic, but the Laplace eigenfunctions are not quantum unique ergodic.

56th Annual Meeting of the Australian Mathematical Society

David Yost*

The 56th Annual Meeting of the Australian Mathematical Society was hosted by the School of Science, Information Technology and Engineering of the University of Ballarat from September 24 to 27, 2012. In all, 227 mathematicians from near and far descended on the University's main campus at Mt Helen for a full four-day program covering a wide range of topics in pure and applied mathematics.

The meeting was again sandwiched between two independently organised workshops. It was preceded by the Early Career Workshop, this time held at the Novotel Resort in Creswick on the weekend 22–23 September. Useful career advice was presented by Sean Carmody from Westpac, Arun Ram from the University of Melbourne and Jacqui Ramagge from the University of Wollongong. Immediately after the end of the conference was another ALTC Professional Development Workshop, held at Mt Helen 27–28 September, and whose report follows this one.

The conference proper began off campus on the Sunday evening with a registration desk and welcome reception at the Mercure Hotel. The official opening took place on Monday morning with Deputy Vice-Chancellor Research Frank Stagnitti welcoming participants, and saying a few words about the University of Ballarat's history of mathematics research and teaching. This was followed by presentation of the Australian Mathematical Society medal to Stephen Keith (in absentia) and Anthony Henderson, and the George Szekeres medal to Ross Street and Neil Trudinger, with short talks by each of them. A report on the medal winners, with their citations, appeared in the last issue of the *Gazette*.

The 11 plenary lectures given by internationally renowned mathematicians were broadly accessible, and provided an opportunity for all participants to learn of developments outside their own specializations. The speakers included four overseas visitors (Assaf Naor, Narutaka Ozawa, Michel Brion and Henning Haahr Andersen) and some of Australia's best (Mary Myerscough, Sid Morris, Fedor Sukochev, Neil Trudinger, Kate Smith-Miles, Scott Morrison and Aidan Sims).

The special sessions are a major reason people keep coming back to these meetings, providing everyone an opportunity to interact with mathematicians in their own speciality. There were 18 in all this time, with particularly large sessions in Mathematical Physics, Geometry & Topology, and Group Actions.

The meeting is always an important opportunity for students to present their work, with 50 short talks by PhD students altogether. The $1000 Neumann prize for the

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best student talk was awarded to Imam Tashdid ul Alam from ANU for his talk entitled 'The Interplay between Discrete Holomorphicity and Integrability in the Z_N model'.

Peter Taylor (left) and Imam Tashdid ul Alam (right)

Following a recent tradition, there was again an Education Afternoon on the Tuesday, aimed at undergraduates, teachers, and prospective mathematics teachers. This public event included two general interest talks, and a panel discussion on primary mathematics. It was attended not only by conference registrants, but also a few dozen secondary school teachers and students. The University of Ballarat's annual Alexander Rubinov Memorial Lecture was incorporated into this event, thus serving as the traditional Public Lecture of the AustMS Annual Meeting. Presented by Manfred Lenzen, the topic 'Think global — act local: a new quantitative view on how our actions affect the environment worldwide' provided a serendipitous introduction to the general theme of the Mathematics of Planet Earth. It can be accessed at http://www.ballarat.edu.au/schools/school-of-science-and-technology/research/centre-for-applied-informatics-and-optimization-ciao/rubinov-lecture-series.

Other social events at the conference included a Women's Lunch on the Monday, and the Conference Dinner on the Wednesday evening. Entertainment at the dinner was provided by the mathematician/comedian Simon Pampena.

The next annual meeting is of course being hosted by the University of Sydney. I wish Laurentiu Paunescu and his team all the best with the organisation thereof.

2012 Professional Development Workshop

Annual Meeting of the Australian Mathematical Society

27–28 September 2012, University of Ballarat

Leigh Wood*

The *Effective Learning, Effective Teaching in the Quantitative Disciplines* professional development workshop was held at the well-appointed Caro Convention Centre at the St Helen campus of the University of Ballarat. The workshop was held in conjunction with the 56th Annual Meeting of the AustMS.

We thank the School of Science, Information Technology & Engineering at the University of Ballarat for helping with the setup of the workshop. The workshop started on Thursday evening with dinner followed by a trivia competition. A member of the winning team said that if his Head of School knew how many differential equations he could solve, the HoS would be aghast — algebraists are not supposed to be so good at DEs!

The first plenary on Friday was given by Dr Robert Layton, a graduate of the University of Ballarat. We started each of the professional development days by showcasing a graduate and the teaching practices of the host institution. Robert's message was that he responded positively to teaching that displayed passion about research and involved active applied learning. He gave an example of a unit in game theory where he could work on problems and see clear applications. He is now working on cybercrime and is applying his knowledge of linear algebra and metric spaces. Here are his points for students, lecturers and curriculum designers:

- blind experimentation only gets you some of the distance
- understanding the application rather than relying on a 'black box' technique gets better results
- learning how algorithms work is more efficient in the long run
- learn widely — concepts from other fields will help you when you least expect it.

Jason Giri, Deputy Dean, Science and Mathematics, at the University of Ballarat, presented the second plenary. Jason described a curriculum redesign that has been successful in significantly increasing the numbers of students studying mathematics units at the University. The Department collaboratively defined the topics that were important for the student cohort and then gave the units appealing names, for example *Bits, Bytes and Algorithms* (a unit in discrete mathematics). This was a pedagogical and marketing exercise that has reaped benefits for both the Department and for the students, as many more students are now studying mathematics. Students start with a subject *On the Shoulders of Giants* that covers the history

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of mathematics in such a way as to review and teach prerequisite mathematical knowledge, as well as present an appetiser of other units in the mathematics sequence.

Dann Mallet (QUT) presented a workshop on Threshold Learning Outcomes (TLO) in the mathematical sciences. This is a project, funded by the Office of Learning and Teaching, to define minimum standards for a graduate of a mathematics degree or major. This is a difficult exercise and the group found it challenging to define these standards. The proposal is to go beyond a list of topics and instead to try to define the knowledge, skills and attributes of a mathematics graduate. It is important that the mathematics community gets involved in defining these standards as we will be the ones who will have to demonstrate to TEQSA that our degrees meet them. Dann will be seeking input and involvement from academics around the country, so make sure to be involved.

Then there were two workshops on assessment. The first was on task design. This is a hot area in mathematics education internationally as computer assessment becomes more common and commercial interests are moving into tertiary learning and teaching. If we have TLOs for a mathematics degree then we have to measure these using assessment. As such, the tasks need to be well designed so that they assess the outcomes required. Standards of achievement need to be defined in a way that is not only quantitative, but provides a qualitative statement of the outcomes. This is a challenge for mathematicians who are comfortable with their current numerical grading systems.

The second workshop was presented by Katherine Seaton (La Trobe) who gave ideas about what has worked for her university. Her department uses worksheets to guide students through the weekly learning and practice. Useful and effective techniques include marking only small parts of homework and making use of the Pearson online mathematics tasks. There was much discussion about the weighting of final examinations and other university policy requirements.

The discussions throughout the event were fruitful and good networks were established between participants. This was the last year of funding for the workshops from the ALTC. In 2013, there are good opportunities for professional development through the Delta conference (24–29 November, Kiama, NSW) and EMAC (1–4 December, Brisbane, Queensland). The Delta conference covers tertiary mathematics education and has speakers from the southern hemisphere. The conference is an excellent way to meet others and keep up to date with international trends. EMAC has a mathematics education stream and is particularly useful for those teaching service mathematics and statistics to engineering students. Both of these conferences have refereed journals for proceedings.

Visit www.austms.org.au/ALTC+Workshop+2012 to see slides from the workshop.

The AustMS professional development unit (www.austms.org.au/Professional+Development+Unit) continues under the coordination of Katherine Seaton. Many universities are accrediting the unit as part of their Graduate Certificates and Graduate Diplomas. This is a good outcome for the Australian Mathematical Society as we now have professional development specifically targeted at the mathematical sciences.

Brian John Day

16 January 1945 – 16 June 2012

Left to right: Michael Batanin, Brian Day and Ross Street, at Brian's 60th birthday celebration in 2005.

Brian John Day was the second child of David John (1910–2002) and Lillian Edna Day (née Hutchinson; 1912–1995) of Gladesville, Sydney. Brian's father worked at the Eveleigh Railway Yards as a fitter and turner until he joined the armed forces for the second World War. He served the RAAF as an aircraft engineer in Port Moresby until after the war, then transferred to Canberra. He was a technical officer with the Department of Supply until retirement. Brian's late brother Allan was professionally involved in Secondary and Higher Education in NSW.

Brian grew up in the family home in Gladesville attending Gladesville Public School and then Fort Street High School.

I met Brian Day in 1962 when we were first-year undergraduates at the University of Sydney. In 1965, as Pure Mathematics Honours students, we shared an office in the two-year-old Carslaw Building. We both enjoyed the Honours courses on category theory and general topology by Dr Max Kelly. So it is not surprising that we both started our postgraduate work under Max's supervision in 1966. While our projects were quite different, Brian and I then began the conversations about our research that went on until his death.

Brian completed his Masters thesis in 1968 at the University of Sydney. Actually, that thesis was already of PhD quality. Using categories, it explained the rationale between two existing convenient variants of the notion of topological space: compactly generated spaces and Spanier's quasi-topological spaces.

Max Kelly moved to the University of New South Wales and Brian completed his PhD thesis in 1970 at UNSW. This work is considered a categorical classic, introducing a powerful technique now known internationally as ‘Day Convolution’.

During that time, Brian and Max were working on many projects. Brian’s paper, joint with Max and appearing in the Proceedings of the Cambridge Philosophical Society in 1970, was a contribution to topology well ahead of its time. Its importance, even to category theory, was missed for many years. It is now recognised as another classic.

These early papers set the stage for ‘enriched category theory’ showing how far the ordinary theory could be powerfully extended. This subject is one of the areas for which Australian Category Theory is especially famous. Many of Brian’s early papers were published in *Bulletin AustMS* and *JAustMS*.

Brian spent the two academic years 1970–1972 as Instructor in Mathematics at the University of Chicago and the period December 1972 – May 1973 as Lecturer in Mathematics at the University of Århus, Denmark.

While Brian did little driving in Australia, he did drive a car in the USA touring the country with a colleague Bill Mitchell from Chicago.

Starting as a Tutor in Mathematics at the University of Sydney during July 1973, Brian converted to a Lectureship in March 1974. His experience teaching both then and in Chicago demonstrated to him that he would be more effective with research than with teaching.

Max Kelly obtained one of the few early grants to mathematics from the Australian Research Committee and was able to employ Brian as a Postdoctoral Research Fellow for the full years 1976–1979.

Between 1981 and 2011 Brian became a Senior Research Assistant, Research Fellow and eventually Honorary Associate in Mathematics at Macquarie. Nevertheless, his attachment and contribution to the Macquarie category theory group CoACT goes back to the 1970s. Working mainly from home, he made significant contributions to CoACT’s ARC research projects, helped guide postgraduate students, and published papers in scholarly mathematical journals.

Not wishing to use email or computers, he preferred telephone as his main tool of communication. He would also send ordinary local and international letters, and occasionally speak at seminars. Within the last year, Mike Barr from McGill University (Canada) received an airmail letter from Brian. Mike said he could not remember the last time he had actually received a handwritten letter!

Some of Brian’s papers are written with international colleagues. I am pleased that our local collaborations led to joint papers, sometimes with graduate students. When we were working on a joint paper, we could exchange as many as ten telephone calls in one day.

Brian’s research contribution to mathematics, especially category theory, topology and topological algebra, was represented by more than 70 publications. His influence has extended beyond that to areas such as theoretical computer science, homotopy theory and theoretical physics.

Brian was unable to make phone calls after mid-May 2012. That was profoundly frustrating for him. The category theorists at Macquarie are missing those calls, to hear his new ideas, and to test our own ideas with an expert.

Acknowledgement. Thanks to Brian's nephew Dr Robert Day for the family material.

Ross Street, Department of Mathematics, Macquarie University, Australia.

Alexei V. Pokrovskii — in memorium

2 June 1948 – 1 September 2010

Alexei Vadimovich Pokrovskii was an outstanding mathematician, a scientist with very broad mathematical interests, and a pioneer in the mathematical theory of systems with hysteresis. He died unexpectedly on September 1, 2010 at the age of 62. For the previous nine years he had been Professor of Applied Mathematics at University College Cork in Ireland.

The main body of Alexei's work centred on nonlinear dynamical systems including systems with hysteresis, discontinuous and nonsmooth systems, control theory, nonlinear functional analysis and applied mathematical modelling. However, the remarkable diversity of his research was broader and included, at different stages of his work, contributions to game theory, stochastic systems, complexity and general functional analysis. He had a particular penchant for combinatorial and probabilistic methods, which appeared repeatedly throughout his many publications. In 1983 he was awarded the prestigious Andronov prize by the USSR Academy of Sciences.

Alexei was born in Voronezh, a city in Central Russia about 500 kilometres south of Moscow. His family had long standing connections with medicine, but Alexei's outstanding mathematical talents were apparent very early. In fact, he already published his first paper as a teenager. He attended the Voronezh State University in 1966–1971, where he received his BSc and MSc degrees in mathematics. He completed his equivalent of a PhD in 1974 under the supervision of Mark Alexandrovich Krasnosel'skii, one of Russia's foremost mathematicians at that time and founder of a famous mathematical school of Nonlinear Functional Analysis. He moved with Krasnosel'skii to the Institute for Control Problems of the Russian Academy of Sciences in Moscow, where Krasnosel'skii's group began systematically to investigate the mathematical foundations of hysteresis. Alexei played an important role in this development, a milestone of which was the publication of the very influential monograph *Systems with Hysteresis* (M.A. Krasnosel'skii and A.V. Pokrovskii, Springer, 1989).

The collapse of the Soviet Union was a very difficult period for scientists there and, like many of his colleagues, Alexei left Russia. He spent the years 1992 to 1997 in Australia on various research grant funded positions with Phil Diamond in Brisbane and Peter Kloeden in Geelong. This Australian period was very productive resulting in around 50 publications on nonlinear dynamics, especially the robustness of the dynamics of chaotic systems under discretisations, which led to development of new mathematical tools such as semi-hyperbolicity and bi-shadowing on the basis of topological degree theory. This culminated in the publication of the electronic monograph *Semihyperbolicity and Bishadowing* (P.M. Diamond, P.E. Kloeden, V. Kozyakin and A. Pokrovskii, e-book, AIMS, 2012) (downloadable free of charge from http://aimsciences.org/books/rcd/rcdVol1.html).

Although Alexei did not have the security of tenure in Australia, the time spent there was, nevertheless, a happy time for him and his family. Alexei cultivated and enjoyed a collective way of doing research, which is apparent from his publications. He had a talent to identify and consolidate interests of his colleagues and involve them in joint research projects. At the same time, he was invariably interested in the research done by others and truly enthusiastic about their achievements and success. Given his method of work, the huge number of collaborators that Alexei had comes as no surprise. In particular, many Russian colleagues of Alexei visited Australia and enjoyed the welcoming warm hospitality of Pokrovskii's family. They included N.A. Bobylev, V.A. Bondarenko, M.L. Kleptsyna, V.S. Kozyakin, A.M. Krasnosel'skii, N.A. Kuznetsov, B.N. Sadovskii, A.A. Vladimirov and I.G. Vladimirov.

In 1997 Alexei moved to Cork, to be closer to European centres of mathematical research, especially, to centres of active 'hysteretic life'. At first, he had an untenured research position, but his talents quickly became apparent and he was offered a full profesorship in applied mathematics. In Cork, Alexei maintained the momentum of his research activities in Australia, although now burdened with academic adminstration. He enjoyed modelling as much as analysis and valued collaboration with colleagues from other disciplines, finding it both interesting and stimulating. Research themes at this time included modelling hysteresis in macroeconomics, soil-water hysteresis in hydrology, epidemics and seasonal dynamics of wild bird populations, canard solutions and chaos in nonsmooth singularly perturbed systems, bifurcations, and chaos in systems with Preisach hysteresis operator, just to name some.

Alexei's charisma was irresistible. He was incredibly imaginative and infinitely rich in ideas, he was absolutely generous in sharing them with others. In his obituary for Alexei in the *Irish Times* (16 October 2010), Professor Finbarr Holland wrote

> He had a child-like curiosity and wonderment for the scientific world, a deep knowledge of several disparate areas which, combined with a penetrating mind, enabled him to make significant progress in whatever problem that took his interest. But he also took a keen interest in other people's work, and whenever somebody shared a surprising new fact with him, his countenance would alter, his eyes would sparkle with delight, and one would get the 'thumbs up', signifying his pleasure. Such a response was very encouraging to the person sharing the information,

> especially to a young researcher, still unsure of his or her own ability. He was immensely generous with his time and talents, and warm-hearted in attributing to others ideas that were very often his alone, qualities which endeared him to his students. In truth, he was a polymath of the first rank.

Alexei was indeed an outstanding mathematician with a very special way with people. He was loved by everyone who knew him and is sadly missed by all. His wife Natasha works at the Tyndall National Institute in Cork. His daughter Olya returned to family tradition to study medicine and is now specializing in ophthalmology. Alexei's son Alexei Jr. continues in his father's footsteps, first taking his degree in mathematics at the University of Cambridge and now doing a PhD in graph theory at the London School of Economics.

A special memorial issue of the journal *Discrete & Continuous Dynamical Systems, Series B,* dedicated to Alexei will be published this year.

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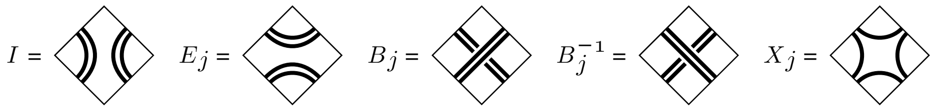
Logarithmic superconformal minimal models

Elena Tartaglia*

Polymers and percolation in two dimensions can be solved exactly [1] at criticality by studying lattice loop models in the form of *logarithmic minimal models* [7] specified by a primitive root of unity x. Algebraically, these models are described by the planar Temperley–Lieb algebra [8], [4] with degrees of freedom consisting of polymer segments or connectivities which are self-avoiding.

To allow for crossings and knotting and to construct generalised loop models called *logarithmic superconformal minimal models* [6], we move to the fused (doubled) Temperley-Lieb algebra (which is a one-parameter specialisation of the Birman-Wenzl-Murakami braid monoid algebra [5, 2]). The generators of this diagrammatic algebra,



are not all independent since they satisfy

$$B_j = B_j^{-1} + (x^2 - x^{-2})(E_j - I) \tag{1}$$

$$2(x + x^{-1})X_j = (x^2 + x^{-2})(I + E_j) - (B_j + B_j^{-1}) \tag{2}$$

as well as the usual braid-monoid relations and a cubic in the braids B_j[9].

Configurations of our models are generated by tiling the square lattice with the generators I, E_j, B_j and B_j^{-1} or equivalently I, E_j and X_j. Typical configurations are shown in Figure 1. Each closed loop in a configuration is assigned the weight or *loop fugacity*

$$\beta_2 = x^2 + 1 + \frac{1}{x^2} \tag{3}$$

A single closed loop with weight $\beta_2 = 1$ is shown in Figure 1(b).

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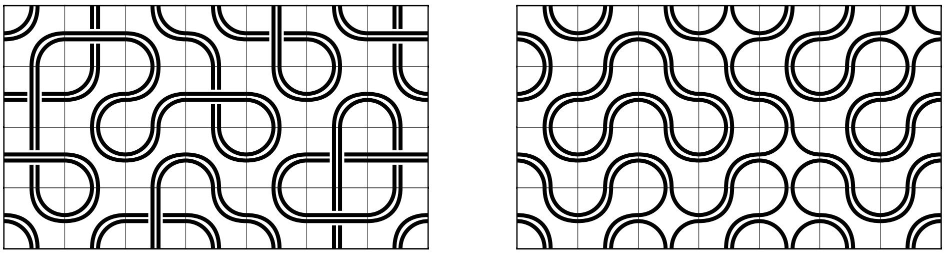
Elena Tartaglia was awarded the A.J. Guttmann Prize for the best student talk at the inaugural ANZAMP meeting in December 2012. This extended abstract is an invited contribution to the *Gazette*.



(a) Superconformal polymers (b) Superconformal percolation

Figure 1. Typical lattice configurations of (a) superconformal polymers ($x = e^{\pi i/2}$, $\beta_2 = 0$) with generators I, E_j, B_j, B_j^{-1} and (b) superconformal percolation ($x = e^{2\pi i/3}$, $\beta_2 = 1$) with generators I, E_j and X_j. The superconformal polymer segments can cross and knot but not form closed loops. The inter-connecting connectivities of superconformal percolation form clusters which can percolate from one side of the lattice to the other.

The critical behaviour of lattice statistical models is encapsulated in a set of numbers $\{\Delta\}$ called *conformal dimensions* which succinctly encode the power-law scaling behaviours of the thermodynamic functions and physical quantities. For simple *rational* theories, this set of numbers is *finite*. In stark contrast, for *logarithmic* theories, this set of numbers is *infinite*. Using specialised Yang–Baxter techniques [1] and the methods of Conformal Field Theory [3], we obtain the complete set of conformal dimensions for any root of unity x including

$$\text{Superconformal Polymers: } \Delta \in \big\{ -\tfrac{1}{16}, -\tfrac{1}{6}, 0, \tfrac{13}{48}, \tfrac{1}{3}, \tfrac{1}{2}, \tfrac{15}{16}, 1, \ldots \big\} \tag{4}$$

$$\text{Superconformal Percolation: } \Delta \in \big\{ -\tfrac{1}{16}, 0, \tfrac{1}{16}, \tfrac{3}{16}, \tfrac{1}{4}, \tfrac{1}{2}, \tfrac{9}{16}, \tfrac{11}{16}, \ldots \big\} \tag{5}$$

A negative conformal dimension indicates that the theory is *nonunitary* and that the associated physical quantity diverges at criticality. These numbers completely characterise the *universality class* of critical behaviour for these new theories.

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Elena completed a Master of Science (Mathematics & Statistics) in 2012 with supervisors Paul Pearce and Jørgen Rasmussen at the University of Melbourne. She is currently studying for a PhD on superconformal logarithmic minimal models and their generalisations under the supervision of Paul Pearce.

Lift-Off Fellowship report: Constructions of mutually unbiased bases

Joanne L. Hall*

My research uses combinatorial and algebraic techniques to investigate structures of importance in cryptography and information theory.

I used the Lift-off funding for three things. Time to write a publication from my thesis [1], a research visitor and attendance at the AustMS conference and Early Career Workshop.

I arranged for Associate Professor Diane Donovan from the University of Queensland to visit RMIT for one week. Associate Professor Asha Rao (RMIT), Associate Professor Diane Donovan and I spent some intensive time around a whiteboard working on the problem outlined below.

I presented some results from my PhD thesis at the 55th Annual AustMS Meeting in Wollongong, and attended the Early Career Workshop held in the days before. The highlight of these events for me was the discussion on balancing family responsibilities with a research career.

In the final stages of writing my thesis I had an idea surrounding the construction of mutually unbiased bases. This idea was the focus of my research during the Lift-Off Fellowship.

Mutually unbiased bases (MUBs) are an important tool in quantum information theory. Two orthonormal bases B_1 and B_2 of $\mathbb{C}^d$ are *unbiased* if $|\langle\vec{x}|\vec{y}\rangle| = 1/\sqrt{d}$ for all $\vec{x} \in B_1$ and $\vec{y} \in B_2$. A set of bases for $\mathbb{C}^d$ which are pairwise unbiased is a set of *mutually unbiased bases* (MUBs).

It is known that there can be maximum of $d+1$ MUBs in $\mathbb{C}^d$ [5]. A set of $d+1$ MUBs in $\mathbb{C}^d$ is called *complete*. It is known that complete sets of MUBs exists when d is a power of a prime [5], however it is unknown if complete sets of MUBs exist in non-prime power dimensions. There are two known families of constructions of complete sets of MUBs, the Planar function construction, and the Alltop construction.

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Theorem 1 (Planar function construction)**.** [4, Theorem 4.1.] *Let $\mathbb{F}_q$ be a field of odd characteristic p. Let $\Pi(x)$ be a planar function on $\mathbb{F}_q$. Let $V_a := \{v_{ab} \colon b \in \mathbb{F}_q\}$ be the set of vectors*

$$\vec{v}_{ab} = \frac{1}{\sqrt{q}}(\omega_p^{\mathrm{tr}(a\Pi(x)+bx)})_{x\in\mathbb{F}_q} = \frac{1}{\sqrt{q}}(\chi(a\Pi(x)+bx))_{x\in\mathbb{F}_q} \quad \text{with } a,b \in \mathbb{F}_q. \tag{1}$$

The standard basis E along with the sets V_a, $a \in \mathbb{F}_q$, form a complete set of $q+1$ MUBs in $\mathbb{C}^q$.

Theorem 2 (Alltop Construction)**.** [3, Theorem 1.] *Let $\mathbb{F}_q$ be a finite field of odd characteristic $p \geq 5$ and $\omega := e^{2i\pi/p}$. Let $V_a := \{\vec{v}_{ab} \colon b \in \mathbb{F}_q\}$ be the set of vectors*

$$\begin{aligned}\vec{v}_{ab} &:= \frac{1}{\sqrt{q}}(\omega^{\mathrm{tr}((x+b)^3+a(x+b))})_{x\in\mathbb{F}_q} \\ &= \frac{1}{\sqrt{q}}(\chi((x+b)^3+a(x+b)))_{x\in\mathbb{F}_q} \quad \text{with } a,b\in\mathbb{F}_q. \end{aligned}\tag{2}$$

The standard basis E along with the sets V_a, $a \in \mathbb{F}_q$, form a complete set of $q+1$ MUBs in $\mathbb{C}^q$.

Let $f_{ab}(x) = (x+b)^3 + a(x+b)$. Then f_{ab} is not of the form $\alpha\Pi(x) + \beta x$ for any planar function Π or any $\alpha, \beta, a, b \in \mathbb{F}_q$. However

$$f_{ab} - f_{cd} = 3(a-c)x^2 + (3a^2 - 3c^2 + b - d)x + (a^3 - c^3 + ba - dc) \tag{3}$$

is a quadratic function. Since all quadratic functions are planar, $f_{ab} - f_{cd}$ can therefore be written in the form $\alpha\Pi(x) + \beta x$ for some $\alpha, \beta \in \mathbb{F}_q$. Hence the differences between the vectors of Alltop type MUBs are Planar function type MUBs.

Conjecture 1. *The set of functions $\{f_{ab}(x) = (a+b)^3 + a(x+b) \colon a, b \in \mathbb{F}_{p^r},\ p > 3\}$, as used in the Alltop construction, is the only set of functions which cannot be written in the form $\alpha\Pi(x) + \beta a$ but the difference of any pair of functions can.*

Initial results have ruled out several families of planar functions [2]. New planar functions are currently being discovered, thus solving for individual families of planar function will not prove (or disprove) this conjecture. A deeper result may be required. On the other hand if we do find a counter example, then we will have a new construction of mutually unbiased bases; a perhaps more interesting result.

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Dr Hall studied algebra and coding theory for Bachelor and Master degrees at ANU. In 2011 she was awarded a PhD by RMIT University for her thesis *Mutually unbiased bases and related structures* under the supervision of Associate Professor Asha Rao. She spent a postdoctoral year at Charles University in Prague before commencing her current position as Lecturer at QUT.

Lift-Off Fellowship report: A quaternion ensemble of random matrices

Anthony Mays*

The award of this AustMS Lift-Off Fellowship allowed me to travel to Germany, attending a conference in Bonn and visiting the universities of Bielefeld and Regensburg. A tangible result of this award is the pre-print [8],'A real quaternion spherical ensemble of random matrices'.

In the broadest sense, a random matrix is merely a matrix with random numbers in it. In practice these matrices often have some symmetry or unitarity conditions, and the entries are frequently drawn from a Gaussian distribution. We call the set of matrices having such-and-such definition an *ensemble*. The main focus of the field of random matrix theory is to analyse the eigenvalue distribution of the ensemble, although the behaviour of the eigenvectors may also be of interest. It may be expected *a priori* that the eigenvalues of a random matrix are scattered uniformly at random over their support (exhibiting the 'clumpy' patterns typical of such data), however this is far from true and they instead display strongly correlated behaviour. The most striking instance of this arises from the ubiquitous appearance of the product $\prod_{j<k} |\lambda_k - \lambda_j|^\beta$ in the eigenvalue joint probability density function (jpdf), which is the required Jacobian when changing variables from the matrix entries to the matrix eigenvalues. (We will discuss the β parameter below.) Since this product implies that there is a low probability of finding two eigenvalues close to each other, the product is interpreted as eigenvalue repulsion. This repulsion is found in both Hermitian and non-Hermitian matrix ensembles. Another effect of the Vandermonde product is that, by Vandermonde's well-known identity, the eigenvalue jpdf can be rewritten as a determinant. This latter fact is key to the analysis, allowing the powerful tools of linear algebra to be brought to bear on the problem.

Random Hermitian Gaussian matrices found some early applications in physics, largely due to the work of Eugene Wigner. The problem being faced at the time was the analysis of the highly excited states of heavy nuclei. Modelling the problem as a set of interacting particles quickly leads to a set of unwieldy coupled equations. Rather, Wigner [10] suggested that a statistical approach might be more useful, and he conjectured that the distribution of the spacing between energy levels will be well approximated by the eigenvalue spacing distribution of large, real symmetric, Gaussian matrices (this statement became known as the *Wigner surmise*); this expectation was also proposed by Landau and Smorodinsky [7, Lecture 7]. A few years later, it was comprehensively demonstrated that the repulsive

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nature of the energy levels could indeed be modeled by eigenvalues of symmetric matrices, and that the results matched Wigner's predictions. Building on this work, Dyson [2] found that these random matrices naturally fell into three classes: real symmetric, complex Hermitian and real quaternion self-dual; a result which is fundamentally due to a theorem of Frobenius that there are exactly three associative division algebras over the reals. It turns out that the parameter β in the Vandermonde product above corresponds to the number of independent real components in these matrix entries: $\beta = 1$ for real ensembles, $\beta = 2$ for complexes and $\beta = 4$ for real quaternions. These values for β have become known as the *Dyson indices*. The ensembles corresponding to these values of β are called the Gaussian orthogonal (GOE), unitary (GUE) and symplectic (GSE) ensembles respectively, due to the invariance properties of their density functions.

Analogous ensembles (which have come to be known as *Ginibre ensembles*) of non-symmetric real, non-Hermitian complex and non-self-dual real quaternion matrices (with Gaussian entries) were introduced in [4], with matching Dyson indices. However, the lack of unitary diagonalizability caused significant complications for the real case, meaning that analytical progress was delayed until the early 1990s. For these non-Hermitian matrices, it is now standard practice to sacrifice orthogonal/unitary diagonalizabilty for orthogonal/unitary *triangulizability* by using the Schur decomposition. Whereas the eigenvalues of Hermitian matrices are all real, the eigenvalues of non-Hermitian matrices are (in general) complex: $N \times N$ complex matrices have N independent complex eigenvalues; $2N \times 2N$ real quaternion matrices have N complex-conjugate pairs of eigenvalues; and $N \times N$ real matrices have k real eigenvalues and $(N-k)/2$ complex-conjugate pairs. Further, given the eigenvalue repulsion implied by the Vandermonde product, we note that the complex-conjugate pairs in the real and real quaternion ensembles result in an effective repulsion of eigenvalues from the real axis (except for the strictly real eigenvalues in the real ensembles). This is demonstrated in the simulations of Figure 1. Note that (except for near the real line) the eigenvalues are roughly uniformly distributed on a disk, which, before scaling is of radius proportional to $\sqrt{N}$. This is a consequence of a universality result — called the *circular law* — which says that in the limit of large matrix dimension the eigenvalue density, suitably scaled, of any matrix with independently and identically distributed (iid) entries (assuming finite mean and unit variance) is uniform on the unit disk [9]. The analogous result for Hermitian ensembles is the *semi-circular law*: that the (scaled) eigenvalue density is a semi-circle of unit radius [1].

If we now take two matrices A, B from the same Ginibre ensemble and form the product $Y = A^{-1}B$, then we have formed a so-called *spherical ensemble*[1]. To see the origin of the name, we stereographically the project the eigenvalues of simulations of real, complex and real quaternion spherical ensembles in Figure 2. The complex ensemble yields eigenvalues that are uniformly distributed over the sphere; the real ensemble has a clear ring of eigenvalues on a great circle corresponding to the real line; and the eigenvalue density for the real quaternion ensemble splits

[1]The eigenvalues of $Y = A^{-1}B$ are equivalent to the *generalized eigenvalues* of A and B, which are solutions to $\det(B - \lambda A) = 0$.

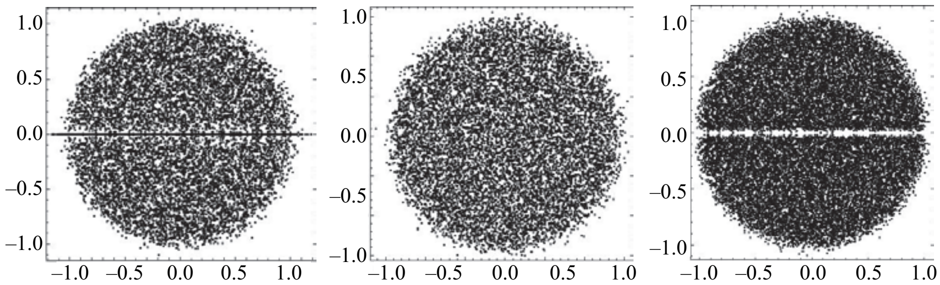

Figure 1. From left to right we have eigenvalue plots for 120 independent 100×100 Ginibre matrices for $\beta = 1$ (real), 2 (complex), 4 (real quaternion).

into two disjoint hemispheres along the same great circle corresponding to the real line. We say that these matrices are in the spherical universality class because of the *spherical law*, which is analogous to the circular and semi-circular laws discussed above. It states that for two matrices with iid entries, having mean zero and finite variance (in other words, obeying the circular law), then in the limit of large matrix dimension the eigenvalues of the product $Y = A^{-1}B$ are uniformly distributed on the sphere (after stereographic projection).

The eigenvalue correlation functions for the complex ($\beta = 2$) case were studied in [6] and the real ($\beta = 1$) case in [3]. The work done during this Fellowship, and contained in [8], was on the calculation of the correlation functions for the ensemble corresponding to the last of the Dyson indices, real quaternion ($\beta = 4$). The procedure first involves changing variables from the elements of A and B (each an $N \times N$ matrix with Gaussian real quaternion entries) to the elements of $Y = A^{-1}B$, which entails integrating out $4N^2$ degrees of freedom; then further changing variables to the eigenvalues of Y, integrating out another $4N(N-1)$ variables, leaving just the $2N$ complex eigenvalues. Next, a Pfaffian[3] form of the ensemble average is written down and we find polynomials (called *skew-orthogonal polynomials*) that will skew-diagonalize the matrix in the Pfaffian. Armed with

[3]For an even dimensional matrix X, which is skew-Hermitian ($X^\dagger = -X$), $\mathrm{Pf}(X) = \sqrt{\det X}$.

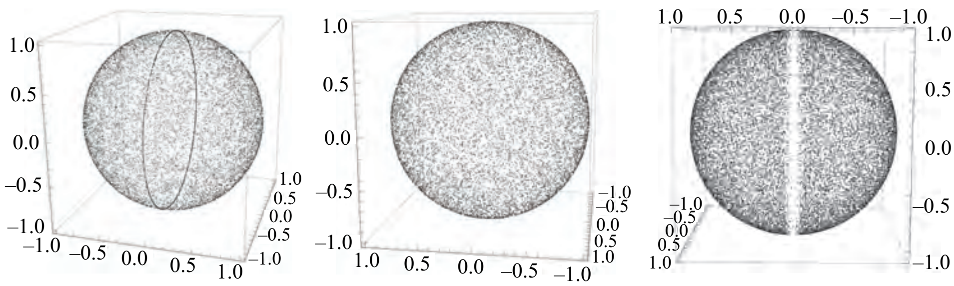

Figure 2. From left to right we have eigenvalue plots for 120 independent 100×100 asymmetric matrices for $\beta = 1$ (real), 2 (complex), 4 (real quaternion).

these polynomials we are then able to obtain the eigenvalue correlation functions by functional differentiation of the ensemble average. Lastly, we take various limits to find that the eigenvalues are indeed uniformly distributed over the sphere for large N (a consequence of the spherical law), and further, that by zooming in on the sphere near the great circle corresponding to the real line, we recover the same correlation functions as in the real Ginibre ensemble [5].

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After growing up in the suburbs of Melbourne, Anthony Mays completed a Bachelor degree in economics and Mandarin Chinese at Monash University. He then undertook a second degree in mathematics and physics before moving to Melbourne University to graduate with honours in mathematics. Continuing on at Melbourne University with a PhD under Peter Forrester, he studied the eigenvalue correlation functions of various random matrix ensembles. The title of his doctoral thesis was *A geometrical triumvirate of real random matrices*, which he submitted in 2011. Since then, he has been a research assistant at Vanderbilt University, and has been awarded a LiftOff Fellowship by the Australian Mathematical Society. He is currently a postdoctoral researcher at Supélec in France. Anthony is also keen juggler and has a strong interest in the mathematics of juggling — the title of his Honours thesis was *Combinatorial aspects of juggling*, for which he received the Wyselaskie Scholarship in Mathematics.

Lift-Off Fellowship report:
A strong Oka principle for circular domains

Tyson Ritter*

In complex geometry, *Stein manifolds* are of fundamental importance as those complex manifolds with a rich supply of holomorphic (that is, complex differentiable) functions from them to the complex numbers $\mathbb{C}$. When studying holomorphically defined problems on Stein manifolds, an interesting phenomenon can arise in which the existence of a continuous solution is enough to give a holomorphic solution. This is somewhat surprising as holomorphic maps are much more rigid than continuous maps, so we would not necessarily expect that the only obstruction to solving a holomorphic problem is topological in nature. In such instances we say that the *Oka principle* holds, named for Kiyoshi Oka who gave one of the first results of this kind in 1939, showing that the holomorphic and topological classifications of line bundles over a Stein manifold are the same.

While it has long been clear that the suitable notion of a manifold having many holomorphic functions into $\mathbb{C}$ is that of being Stein, it has only recently become clear what an appropriate dual notion should be. Following Gromov's seminal paper on the Oka principle in 1989 [3], Forstnerič [1] recently introduced the class of *Oka manifolds* as those satisfying a number of equivalent so-called *Oka properties*, each stating in some way that there are many holomorphic maps from $\mathbb{C}$ into the manifold (see [2] for a recent survey). One of the simplest such statements is Gromov's Oka property, that every continuous map from a Stein manifold into an Oka manifold can be continuously deformed into a holomorphic map.

There are still many open questions relating to Oka manifolds. For instance, the embedding theorem for Stein manifolds states that every Stein manifold S of dimension n can be embedded (properly holomorphically) as a closed submanifold of $\mathbb{C}^N$, for $N = 2n + 1$. In this case the embedding is clearly a homotopy equivalence between S and its image, yet we can relax this and ask that the embedding instead be a homotopy equivalence between S and the entire target manifold. We call such an embedding *acyclic*. Of course, as soon as S has non-trivial topology we need to allow more general targets than $\mathbb{C}^N$, the most natural generalisation being to consider targets that are, like $\mathbb{C}^N$, both Stein and Oka. The question then becomes, does every Stein manifold have an acyclic embedding into a Stein Oka manifold? Additional motivation for this question arises from the holomorphic homotopy theory of Lárusson [4].

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During my PhD I considered this question in the simplest non-trivial case, namely for 1-dimensional Stein manifolds, which are precisely the open (that is, non-compact) Riemann surfaces. I proved that every open Riemann surface with abelian fundamental group acyclically embeds into a 2-dimensional Stein Oka manifold [5], and more generally that every open Riemann surface acyclically embeds into an Oka manifold [6]. In the more general setting the question of whether the targets are Stein remains unanswered, and appears to be very difficult.

An important ingredient in these results is the following *strong Oka principle*, named such as it is a strengthening of Gromov's Oka principle for the special case of maps from circular domains into the Stein Oka manifold $\mathbb{C} \times \mathbb{C}^*$ (where $\mathbb{C}^* = \mathbb{C} \setminus \{0\}$). A *circular domain* is any domain in $\mathbb{C}$ given as the open unit disc from which a finite number of smaller pairwise disjoint closed discs of positive radii have been removed.

Strong Oka Principle. ([5].) *Every continuous map from a circular domain to* $\mathbb{C} \times \mathbb{C}^*$ *can be continuously deformed into a proper holomorphic embedding.*

During my Lift-Off Fellowship I focused on extending the strong Oka principle to the case of punctured circular domains, that is, circular domains from which a finite number of points have been removed. The simplest such case is the unit disc with a finite number of punctures and no holes. While it is easy to handle a single puncture, the problem becomes considerably more difficult as soon as two punctures are permitted, with difficulties arising when the punctures are both extremely close to the origin. In this case it is possible to show that some homotopy classes of continuous maps contain proper embeddings, but difficulties arise and further investigation is needed when the winding numbers about the two punctures are large and opposite in sign.

I will continue my research on punctured circular domains, together with other related problems in Oka theory, during my time as an ARC Research Associate at the University of Adelaide with Associate Professor Finnur Lárusson. I wish to thank the AustMS for the Lift-Off Fellowship that has enabled me to lay important groundwork for my future research, and to the University of Adelaide for support during my time as a Lift-Off Fellow. I strongly encourage all PhD students to consider applying for the Lift-Off Fellowship after submitting their thesis.

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Tyson Ritter completed his undergraduate study in 2004 at the University of Adelaide with bachelor degrees in Physics, Electrical Engineering and Pure Mathematics (Honours). After working as a Research Engineer for several years, he returned to study in 2008, obtaining his PhD in Pure Mathematics from the University of Adelaide in 2011 under the supervision of Associate Professor Finnur Lárusson. He now works in the School of Mathematical Sciences at the University of Adelaide as an ARC Research Associate in the areas of complex geometry and complex analysis.

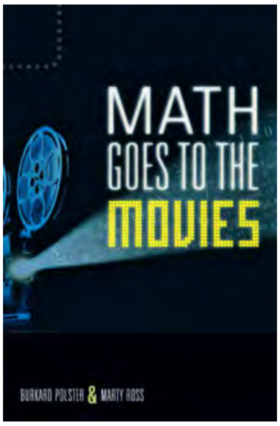
Book Reviews

Math Goes to the Movies

Burkard Polster and Marty Ross
Johns Hopkins University Press, 2012, ISBN: 978-1-4214-0483-7 (hardback)
Also available in paperback (ISBN 978-1-4214-0484-4) and for Kindle

This is an entertaining grab bag of mathematical and movie titbits that will delight mathematically minded movie buffs. The authors also have a website that includes links to relevant movie clips, and the whole project will appeal especially, perhaps, to students and teachers of mathematics. But I can do no better than to use the authors' own words to sum up the aim of *Math Goes to the Movies*:

> Our goal is to complement and significantly extend the available information about math in the movies. . . : in conjunction with our website, we have endeavored to hunt down and to describe all the "good stuff", the scenes we believe are of general appeal and usefulness. Furthermore, our emphasis is really on the math and the fun of seeing it on the big screen, not on anything else. The flipside is that our book probably offers little to experts in cinema studies and serious movie critics.



This last sentence notwithstanding, the book is designed to be 'functionally encyclopedic' in its detailed, cross-referenced lists: movies containing various levels and amounts of mathematics, famous topics and famous mathematicians who appear in movies, famous actors who have played those famous mathematicians, the mathematics consultants who have worked on these movies, and more. These lists constitute the last two chapters (or Part III) of the book. But *Math Goes to the Movies* is far more than lists of facts and figures about movie maths. Part I (Chapters 1–12) focuses on a number of films to which the authors devote more in-depth discussions — beginning with four of the most famous: *Good Will Hunting*, *A Beautiful Mind*, *Stand and Deliver*, and π — while Part II (Chapters 13–19) is organised in terms of key mathematical topics that feature in movies.

The opening chapter of the book begins with a discussion of *Good Will Hunting* from the point of view of the film's mathematics consultant, Patrick O'Donnell, whom Polster and Ross interviewed by telephone. O'Donnell, a physics professor at the University of Toronto, was initially hired as an extra — to play a drunk man in a bar! He was 'spotted' while he was having lunch at a restaurant near the university — but the movie people did their homework and tracked him to his office, where they were so impressed by the 'jottings and wave functions and things' on his board that they invited him to be their consultant. As in most 'mathematical' movies, the mathematics in *Good Will Hunting* is mostly confined to decorative 'props' — blackboards full of equations — but these are vital to the feel and look of the film.

One of the first things O'Donnell noticed was that 'none of the actors could write on a blackboard'. Among his snippets from behind-the-scenes was the fact that if the actors had to 'write and act at the same time', he had to choose material that was suitably 'dumbed down'. David Bayer made a similar discovery — he's the Columbia University mathematics professor who served as consultant to *A Beautiful Mind*, the subject of Chapter 2. As most readers will know, this movie is based on the story of mathematician John Nash, and stars Russell Crowe. Mathematics lecturers in particular will enjoy this recollection from Bayer:

> Russell had actually been very nervous the day that he did the math lecture, where he wrote the problem out and talked to Jennifer [Connelly, who played his student] at the same time in the classroom. And everybody was sitting there astounded: 'You mathematicians really talk and write at the same time?' Here we are taking like twenty takes and no-one was thinking that Russell was a yahoo and everyone is extremely impressed with it. They were basically feeling sympathetic with him that he was trying to pull that scene and they are looking at me, 'You guys do this? You gotta be kidding.'

In a related vein, Columbia mathematician Henry Pinkham, who was the consultant for *The Mirror Has Two Faces*, recalled that the movie's star, Jeff Bridges, who plays a mathematics professor, 'went to a lot of effort to learn lines that would be convincing from a mathematical point of view'.

Another appealing feature of *Math Goes to the Movies* is its photos of some of the blackboard shots in these and other movies discussed — including whiteboards created by Polster and Ross when *they* acted as consultants for an episode of the TV series *City Homicide*. There's also a great shot in which Elizabeth Hurley (playing the Devil in *Bedazzled*) is pointing to a blackboard on which Fermat's Last Theorem is written, followed by 'SHOW YOUR WORK'. As the authors remark, 'this appears to be a very funny jibe at Fermat, as if he were a negligent schoolboy for not including his proof'. More importantly (for mathematical readers), Polster and Ross often expand upon the blackboards' mathematical content.

Indeed, much of the book is devoted to brief, accessible amplifications of some of the mathematics that features in the various movies: graph theory in *Good Will Hunting*; game theory in *A Beautiful Mind*; the nature of pi, the golden ratio, and the Fibonacci sequence (in π, and in the classic 'teaching cartoon' *Donald in Mathmagic Land*); prime numbers (*The Cube*); calculus (*Stand and Deliver* and *The Mirror Has Two Faces*); group theory (*It's My Turn*, of which the authors say that to the best of their knowledge, this is 'the only movie with a scene dedicated to a mathematical proof'); Pythagorean triples and Fermat's Last Theorem (*Star Trek*, *The Simpsons*, and the mathematical musical *Fermat's Last Tango*); the fourth dimension and hypercubes (*Cube 2*) — and more.

The authors' expositions are at a level suitable for the interested lay reader, student, or teacher; they include some neat techniques, such as using elementary number theory to eliminate an apparent counterexample to Fermat's Last Theorem that was used in *The Simpsons* (whereas using a calculator, the numbers chosen appear to 'work', to an accuracy of nine digits). But as I implied in the previous paragraph, Polster and Ross also visit more complex territory, including 'the famous *snake lemma* from homological algebra' (*It's My Turn*). On the other hand, sometimes the authors simply mention mathematical ideas or equations used in movies — often pointing out where the film-makers got it slightly wrong; some readers may want to reach for pen and paper to fill in the gaps for themselves. And for those who like trying their hand at puzzles, there's a chapter called 'Problem Corner', which lists an amazing number of interesting mathematics problems that have appeared in movies; answers and occasional working are provided.

The emphasis in *Math Goes to the Movies* is, naturally enough, on movies, not on television shows, so fans of *Numb3rs*, *Star Trek*, and so on will have to look elsewhere; but Polster and Ross do mention a few scenes from some of these series (and they give references for further information). For instance, the following excerpt — given in Chapter 19, which lists some of the *deliberately* funniest maths scenes in movies (as opposed to the bloopers of Chapter 18) — may keep *Big Bang Theory* fans happy:

> SHELDON: There's some poor woman who's gonna pin her hopes on my sperm. What if she winds up with a toddler who doesn't know if he should use an integral or a differential to solve for the area under a curve?
> LEONARD: I'm sure she'll still love him.
> SHELDON: I wouldn't.

Or perhaps this scene will remind some readers why they *don't* like this series … but either way, there's no doubt something for everyone here. The authors' own favourite comic scene has Abbott and Costello 'proving' that $7 \times 13 = 28$, in the 1941 movie *In the Navy*; this scene, and its method of 'proof', is discussed in more detail in a chapter of its own (Chapter 10). To mention just two more of the many 'funny scenes' listed, there's the wonderfully wry puzzle-solving exchange between Katharine Hepburn and Spencer Tracy in *Desk Set*, and, on a purely trivial level, Woody Allen's quirky response to his drill sergeant in *Love and Death*:

> SERGEANT: One, two, one, two, one, two …
> BORIS (ALLEN): Three comes next, if you're having any trouble.

All in all, *Math Goes to the Movies* is a fun read for anyone interested in mathematics, and doubly fun if you're interested in movies too.

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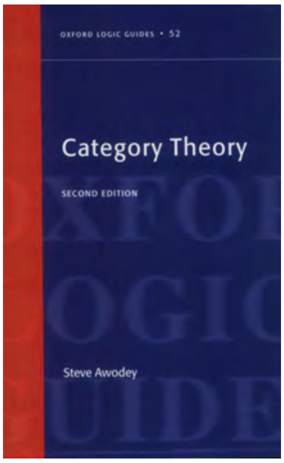
Category Theory

Steve Awodey
Oxford Science Publications, 2010, ISBN 978-0-19-958736-0 (hardback)
Also available in paperback (ISBN 978-0-19-923718-0)

Category Theory was born in 1945 when Eilenberg and Mac Lane formalised their discoveries on the connections between topology and group theory. As Eilenberg said, they defined categories in order to define functors, which they needed to define natural transformations, which they needed to define adjunction. Be that as it may, they quickly realised that category theory is ubiquitous in mathematics, serving as a uniform foundation for algebra, analysis, algebraic geometry, K-theory, number theory, logic and more recently computer science. In particular, set theory can be given a transparent categorical formulation.

Following this definition, some intrinsically categorical concepts, such as duality, universal functions and limits were quickly discovered. Major categorical results appeared, such as Yoneda theory, which describes when a set valued functor F on a category $\mathfrak{C}$ is representable as $\mathrm{Hom}(C, -)$ for some $C \in \mathfrak{C}$, and Kan theory, which explains when adjoints between categories exist.



A dangerous flirtation with logical antinomies such as the Russell paradox occurred when category theorists began working with the category of Sets, and even with the category of Categories. At first they were dealt with by ad hoc methods, such as embedding everything involved in a universe. Later it was realised that it was not necessary to define categories within the confines of set theory, but that one could in fact use category theory as a new foundation for mathematics and instead define set theory within category theory. In particular, topos theory, originally developed by Grothendieck as a tool for algebraic geometry, became a categorical basis for set theory.

Textbooks on category theory aimed at researchers and graduate students in various fields appeared, notably Freyd: *Abelian Categories* in 1964; Ehresmann: *Catégories et Structures* in 1965; Mitchell: *Theory of Categories*, also in 1965; Bucur and Deleanu: *Introduction to the Theory of Categories and Functors* in 1968 and Pareigis: *Categories and Functors* in 1970. Finally the classic text that became the bible for users rather than creators of category theory, Mac Lane's *Categories for the Working Mathematician* appeared in 1971.

Other texts, not only in English, have appeared since then, but I mention these since they set the tone for subsequent category theory textbooks, and form a collective basis for comparison with the text under review, which claims descent from Mac Lane. What these texts have in common is that they are aimed at scholars who already have some familiarity with one or more of the fields to which category theory is applied, usually algebraic topology, group theory, commutative algebra or logic. Thus they assume the reader is already familiar with details of some of the applications discussed, just as a textbook on group theory assumes knowledge of elementary number theory.

Awodey's *Category Theory* is the second edition of an Oxford Logic Guide, first published in 2006. The author is a logician and his book grew from his courses at Carnegie Mellon aimed at advanced undergraduates and graduate students in computer science, mathematics and logic. Thus it assumes somewhat less prior knowledge than Mac Lane in mainstream mathematics, but rather more in mathematical linguistics including the λ-calculus. The early chapters are a careful introduction to category theory in the context of monoids and posets. Later, group theory is presented as a categorical abstraction of the notion of automorphisms of an object with or without structure. Although the mathematical prerequisites are lighter than those of Mac Lane, the standards of rigour are not compromised. A nice feature to my mind is the completeness of the proofs of the more advanced theorems and the thoughtful exercises with full solutions to many of them.

Most of the topics covered in Mac Lane are presented, together with a few more recent developments, particularly those concerned with logic, such as first order classical logic, intuitionistic logic including Heyting algebras, and λ-caculus. A notable omission is Abelian Categories, although all the tools necessary for a definition are already present.

To my mind then, Awodey's book is a worthy successor to Mac Lane, aimed at a less sophisticated audience and so well worth considering as a text for a first course in category theory, or as a preparation for reading advanced papers in the subject.

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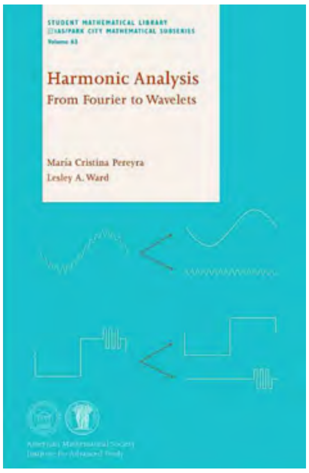
Harmonic Analysis: From Fourier to Wavelets

Maria Cristina Pereyra and Lesley A. Ward
Student Mathematical Library Vol. 63, American Mathematical Society, 2012, ISBN 978-0-8218-7566-7

This is a gentle introduction to Fourier analysis and wavelet theory that requires little background but still manages to explain some of the applications of Fourier and wavelet methods and touch on several current research topics.

The topics covered include the traditional components of a Fourier analysis course, such as Fourier series, convolution, the convergence (or nonconvergence) of a Fourier series and its Abel and Cesàro means, Fourier integrals and senses in which these converge, Plancherel and Parseval theorems, Schwartz functions and tempered distributions. However, there is also a nice discussion of the fast Fourier transform, the Haar basis and the fast Haar transform, including an explanation of why the Haar transform is faster than the Fourier transform, and then more on wavelet and wavelet-like transforms and multiresolution analyses. There is a treatment of two-dimensional image compression (illustrated with photographs of fingerprints and digital versions thereof, and JPEG), and an explanation of how wavelet methods can be used to prove the L^p boundedness of the Hilbert transform.



The authors have taken care to be accessible to undergraduate mathematicians. Functional analysis is largely avoided, and the Lebesgue integral is mentioned but almost all integration is reduced to Riemann integration of continuous functions. Further, by largely avoiding the 'Theorem-Proof' structure, they ensure that students with holes in their mathematical backgrounds should still be able to get to grips with the main issues of Fourier and wavelet analysis. There is a summary of some essential results from analysis in Chapter 2, and an Appendix with more of these, to which reference is often made.

The authors communicate their enthusiasm for harmonic analysis in different ways. Compared to standard texts, this book is characterised by more personal and historical information, including footnotes explaining the *dramatis personae* and references to comparatively recent important work such as Carleson's convergence theorem, without proof but with an explanation of its significance, and mention is made of several papers that are less than ten years old, such as the Green–Tao theorem and results of Hytönen and of Petermichl on the averaging of dyadic operators to get translation-invariant operators such as the Hilbert transform. It comes with many projects for interested students, and lists a number of open-ended problems that suggest further developments and should engage interested students. The reader is given the impression that theory and applications in Harmonic Analysis are feeding off each other in a way that is beneficial for both. At the same time, chapter and section titles such as 'The Fourier transform in paradise', 'A bowl of kernels', 'Monsters, Take 1' and 'Interpolation and a festival of inequalities' illustrate the lively writing style that make the book a pleasure to read.

The authors have taken considerable care with their writing. I noticed only one typo (a wrong sign in the definition of the Hilbert transform in a footnote on page 329). There are one or two places where it might be argued that a little bit more would have been nice (for instance, a comment that Lebesgue measurable functions behave better than Riemann integrable functions as far as pointwise limits are concerned), or that a little bit less would have sufficed (for instance, the proof of the Riemann–Lebesgue lemma for Schwartz functions is arguably overkill). But these are matters of personal taste, and one can always understand the authors' choices, even when one does not entirely agree with them.

In summary, this is a well-written and lively introduction to harmonic analysis that is accessible and stimulating for undergraduates and instructive and amusing for the more sophisticated reader. It could also be argued that the material herein should be part of the knowledge of most undergraduates in mathematics, given that the modern world relies more and more on data compression. It is therefore timely as well. It has certainly earned my enthusiastic recommendation.

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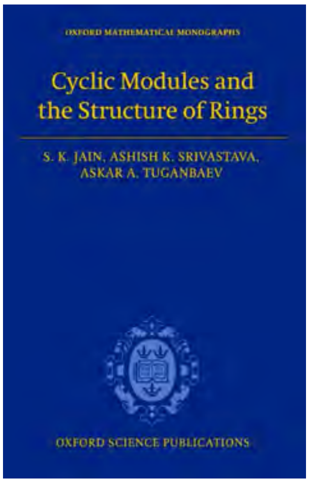
Cyclic Modules and the Structure of Rings

S.K. Jain, Ashish K. Srivastava and Askar A. Tuganbaev
Oxford Science Publications, 2012, ISBN 978-0-19-966451-1

What properties of a ring R are determined by its cyclic right modules? For example, division rings including fields are completely determined by the structure of their cyclic modules: the non-zero cyclic modules are all isomorphic and their endomorphism rings are isomorphic to the ring itself.



This monograph is a survey of 50 years work on the problem of determining the structure of rings over which cyclic modules satisfy various module theoretic properties such as finiteness or homological conditions. The prototype is a classical 1964 result of Osofsky that R is semi-simple Artinian if and only if all cyclic R–modules are injective. For commutative rings, similar results were already proved in 1950 by Cohen: every proper factor ring of R is Artinian if and only if R is Noetherian and non-zero prime ideals are maximal.

In this book, the authors classify rings each of whose proper cyclic modules satisfy ascending or descending chain conditions, homological properties such as injectivity or projectivity, have cyclic or projective essential hull or satisfy several combinations and generalisations of these properties. To capture the flavour of the book, here are two typical results. Each proper cyclic module of R is perfect (i.e. it has a projective cover satisfying some technical conditions) if and only if R is either right perfect, prime or a local domain.

Each cyclic module M is quasi-injective (i.e. every homomorhism of a submodule of M into M extends to an endomorphism of M) if and only if R is a direct sum of a semi-simple Artinian ring and a finite direct sum of self-injective, rank zero, uniserial duo rings with Jacobson radical zero.

Several chapters are devoted to related properties with cyclic replaced by simple or modules replaced by left or right ideals or proper factor modules of R.

The coverage is encyclopedic but the exposition is rather dry. So this volume is important if you work in the area, but is not light reading for the novice.

Phill Schultz
School of Mathematics and Statistics, The University of Western Australia, Crawley, WA 6009, Australia. Email: phill.schultz@uwa.edu.au

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NCMS News

Nalini Joshi*

By now, you will know that Dr Peter Stacey has presented talks about the Decadal Plan for Mathematical Sciences at major cities around Australia. At the first such presentation, attendees from DSTO (Defence Science and Technology Organisation) suggested that additional presentations should be held at locations outside university campuses. This suggestion was also made by members of other government organisations, including CSIRO and ABS. The purpose of this column is to report on the feedback and suggestions that were made at these additional events.

Audience members at these events brought up general points not tied to specific themes identified by subcommittees, but have also responded to several specific themes. I list selected points here. (Please write to me if you would like to have a copy of the full report prepared by Peter Stacey.)

I was particularly happy to see that there was widespread agreement on major issues. Let me offer one striking quote: ‘DSTO needs a strong supply of Australian graduates with mathematical science skill sets or else the future is bleak’. It is also important to note that statisticians at government instrumentalitites have highlighted major concerns different to those expressed by mathematicians at universities.

The general points made were:

- The Mathematical Sciences are enabling technologies which are increasingly important to Australia’s future.
- The Mathematical Sciences face a number of major challenges, risking a significant diminution in Australia’s capabilities.
- There are poor perceptions of the usefulness of mathematics and statistics.
- The number of mathematics and statistics students and lecturers in the university sector is critically low.
- There is underdeveloped mathematical infrastructure for business, industry and research.
- The plan should be to inform government, taking into account that governments come and go, and should not focus on stopgap measures.
- The plan needs to take account of strategic research programs such as *Securing Australia’s Future*[1], identified by the Prime Minister’s Science, Engineering and Innovation Council and the Chief Scientist.

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[1] http://www.acola.org.au/ACOLA/index.php/projects/securing-australia-s-future

Theme[2] related comments

- **[1.3, 4.2]** The demand and supply of mathematical scientists is similar to that in information technology, which was discussed at a recent NICTA forum on ICT Skills. At the forum, impressive results were reported from Group X[3], a group supporting ICT education in Queensland schools, and it was suggested that the initiative could be extended nationwide.
- **[4.2]** DSTO employs about 2300 staff and most research areas need input from those with mathematical science expertise. While DSTO mainly employs graduates at the honours level, there is a stated aim to increase the percentage of PhDs. Most mathematical scientists in DSTO are not classed as mathematicians: there are 35 DSTO positions with 'mathematician' in the title, which is a vast under-representation. There are about 250 'Operations Research' specialists with about 50% on the mathematical side. Mathematical science expertise need not necessarily be acquired in mathematics or statistics degrees, since broader engineering or IT degrees could provide this. We need to look at the standard of mathematics being used: a person is not a mathematician after completing a first year university subject.
- **[4.2]** The situation of statistics identified in the 2005 review was parlous and it has since worsened. There is no 21st century university department or group and groups are all below critical mass. The statistics of big data is almost totally absent. Universities need to collaborate to gain global mass and need to consider professional doctorates in statistics.
- **[4.2]** If statisticians were accredited in the manner of medical officers then employers, including government agencies, would have an assurance of quality. As described at http://www.amstat.org/, in the USA there is a push to create the position of Chief Statistical Scientist in the office of the NSF Director. The similarities and differences between mathematics and statistics need to be teased out, leading to the consideration of possible roles such as Chief Mathematical Scientist or Chief Statistical Scientist. Breakthroughs in statistics have come from a variety of sources, some outside the mathematical sciences. It is important for the discipline of statistics that it is stimulated by the challenges and opportunities that arise in everyday applications. An 'engineering solutions' type role is important for many practising statisticians. The ability to apply statistical/mathematical science to resolve actual problems is equally as important as the ability to develop new techniques and methods. It may be that the most appropriate preparation for data scientists involves elements not currently in statistics degrees. The plan needs to address both the disciplinary and professional aspects of statistics; in order for recommendations to get traction we need to get agreement from both the discipline and the profession.

[2]The item numbers here refer to themes enumerated (after clicking on 'themes') at http://www.mathscidecadalplan.org.au/committees/

[3]http://groupx.edu.au/

The deadline for submissions on the decadal plan has been extended to 30 April 2013 and I look forward to seeing more submissions as well as comments, possibly on the issues described above, on the website www.mathscidecadalplan.org.au.

Nalini Joshi is the Chair of Applied Mathematics at The University of Sydney and was the President of the Australian Mathematical Society during 2008–2010. She was elected a Fellow of the Australian Academy of Science in 2008, became the Chair of the National Committee of Mathematical Sciences in 2011, and was elected to the Council of the Australian Academy of Science in 2012.

AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

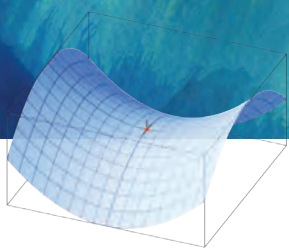
Mathematics of Planet Earth 2013 AUSTRALIA

The 2013 AMSI Winter School

on the

Mathematics of Planet Earth

The University of Queensland
24 June–5 July 2013



The 8th AMSI Winter School is designed for postgraduate students and postdoctoral fellows to develop their mathematical skills and to interact with world-leading mathematical scientists. This year's event will be held in conjunction with the 2013 International Year of Mathematics of Planet Earth.

Introductory courses

Numerical methods on GPUs
Vivien Challis (UQ)

Large-scale inversion for geophysical exploration
Lutz Gross (UQ) and Louise Olsen-Kettle (UQ)

Dynamical systems and singular perturbations
Peter van Heijster (QUT)

Advanced courses

Mathematical modelling of infectious diseases
Geoff Mercer (ANU)

Regularisation of inverse problems in geomathematics
Volker Michel (Universität Siegen)

Optimisation for nature conservation
Hugh Possingham (UQ)

Full travel and accommodation scholarships available
Register at www.amsi.org.au/WS13.php

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AMSI News

Geoff Prince*

AMSI's new Research & Higher Education Committee

This committee advises the AMSI Board and provides high level advice to AMSI management. It is chaired by the AMSI Deputy Director, Mark Gould and its terms of reference include:

- To advise the Board on the overall R&HEd program directions and their alignment with AMSI's mission.
- To initiate and oversee formal and informal reviews of AMSI's R&HEd events and programs. To make recommendations to the AMSI Director, Program Manager and the Board as a result of these reviews.
- To provide advice to the AMSI Program Manager (Research and Higher Education) and the AMSI Director on the resourcing and management of the R&HEd program.
- To monitor and comment on strategic developments affecting AMSI and its membership in Australian R&HEd, both at university/agency/industry levels and at government level.

The committee's members are Mark Gould (chair), Jan de Gier (Summer School), Joe Grotowski (Winter School), Matt Ritchie (BioInfoSummer), Andy Eberhard (Access Grid), Jon Borwein (Scientific Advisory Committee), Norm Dancer (Full Member rep.), Stan Miklavcic (Associate Member rep.), Peter Forrester (AustMS), Geoff Prince and Simi Henderson. A student representative is yet to be appointed as is a representative of AMSI's agency members. Society members are welcome to raise any issues covered by the terms of reference with the committee.

The committee will be reviewing the three annual schools over the next 12 months but the most immediate task is to plan a renewed bid for a *national research centre*. A working party has been set up with a view to having a proposal for the Commonwealth government and its agencies to consider prior to the 2014 budget. The planning process will involve extensive consultation with the AMSI membership and will build upon our last bid and the discussions that have taken place as part of the decadal plan process.

*Australian Mathematical Sciences Institute, Building 161, c/- The University of Melbourne, VIC 3010, Australia. Email: director@amsi.org.au

The disastrous state of the school workforce in mathematics

There have been many reports over the years pointing to the declining numbers of qualified secondary teachers of mathematics in Australia. The latest AMSI discipline profile www.amsi.org.au/images/stories/downloads/pdfs/general-outreach/Discipline_profile_2013.pdf indicates the extent of the problem. In 2008 36% of teachers of years 7 to 10 mathematics had at most one year of tertiary maths or stats and in 2010 this had risen to almost 39%. At years 11 and 12 the figure is around 20% and this didn't change although the percentage with three years of maths or stats slid from 68% to 64% over this period. This raw data is shocking in itself and does not stand up well in international comparisons as Nalini Joshi and I discovered while sitting on an expert working group of the combined academies charged with benchmarking our STEM (Science, Technology, Engineering & Mathematics) performance. But there are deeper and more worrying aspects:

- No Australian government, state or federal, knows how many secondary mathematics teachers graduate each year!
- No Australian government is making any significant effort to upgrade the content knowledge of the roughly 35% of teachers of mathematics who lack the discipline qualification, this is the only measure that will deal with the scale of the problem.
- Two-year pre-placement training for secondary teachers has been mandated by the Commonwealth through the Australian Institute for Teaching and School Leadership www.aitsl.edu.au/, making teaching even less attractive to maths and stats graduates.
- The very significant demand for maths and stats graduates generated by secondary teaching is being masked by the failure of employers to insist on employing qualified graduates. Doubling our graduation rates won't even touch the extent of this shortage.
- The significant low performance tail in our PISA results for mathematics seems to be generated in low SES and regional areas where the shortage of qualified teachers is far more acute than indicated by the national figures above.
- Enrolments in calculus-based mathematics subjects at years 11 and 12 continue their almost 20-year slide, choking the supply of future school maths teachers.

In my view this situation is dire and AMSI will be ramping up its advocacy as the election approaches. I urge everyone reading this column to apply pressure through blogs, social media, opinion pieces and direct contact with politicians. You might want to read AMSI's policy around school teaching at http://www.amsi.org.au/images/stories/downloads/pdfs/general-outreach/policy_document2013.pdf.

On a happier note, have a look at the forthcoming major conference on the Mathematics of Planet Earth theme coming up in July in Melbourne http://mathsofplanetearth.org.au/events/2013. Apart from the remarkable range of the program this is one of the very few occasions when the universities, the government agencies and the private sector have collaborated. Please come along and contribute to the science and the public impact!

I was a Monash undergraduate and took out a La Trobe PhD in 1981 in geometric mechanics and Lie groups. This was followed by a postdoc at the Institute for Advanced Study in Dublin. I've enjoyed teaching at RMIT, UNE and La Trobe. My research interests lie mainly in differential equations, differential geometry and the calculus of variations. I'm a proud Fellow of the Society, currently a Council and Steering Committee Member. I became AMSI director in September 2009.


Early Bird rates!
Mathematics of Planet Earth AUSTRALIA 2013
Mathematics of Planet Earth The Conference
Inspiring new ideas, research and collaboration
8-12 July 2013 – Rydges, Melbourne
A planet at risk
Mitigating natural disaster risk
BioInvasion & bioSecurity
Earth system modelling
A planet organised by humans
Scientific data mining
Complex systems
Realising our subsurface potential
A planet to discover
Environmental modelling
Population censuses & the human face of Australia
A planet supporting life
A data-based view of our world
Speakers include:
David Bailey
University of California
Bronwyn Harch
CSIRO
David Karoly
University of Melbourne
Robert Muir-Wood
Risk Management Solutions
Marc Parlange
Laboratory of Environmental Fluid Mechanics and Hydrology (EFLUM)
Peter Waterhouse
University of Sydney
Chris Budd
University of Bath
Sue Taylor
Australian Bureau of Statistics
An Australian Academy of Science Elizabeth and Frederick White Conference
Register: www.MoPE.org.au/events/2013
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MATHS + STATS BY EMAIL

News

General News

Alf van der Poorten Travelling Fellowship

The Alf van der Poorten Travelling Fellowships aim to assist young mathematicians to travel in Australia and overseas so that they can enrich their mathematical research and initiate international collaborations. The Fellowships are awarded on the basis of academic merit and they are open to researchers in pure mathematics who graduated from in Australian university in the last two years. This fellowship is funded by the family of the late Professor Alf van der Poorten.

Applications for Alf van der Poorten Fellowship should be sent to van.der.Poorten @austms.org.au by 16 May 2013. Enquiries about the Alf van der Poorten Fellowship should be sent to the same email address. Full details about the award and the applications process can be found on the AustMS web site at http://www.austms.org.au/Alf+van+der+Poorten+Travelling+Fellowship.

Call for nominations for ICIAM Prizes for 2015

The ICIAM Prize Committee for 2015 calls for nominations for the five ICIAM Prizes to be awarded in 2015. Each ICIAM Prize has its own special character, but each one is truly international in character. Nominations are therefore welcomed from every part of the world. A nomination should take into account the specifications for a particular prize (see www.iciam.org/council/PrizeDescriptions.pdf), and should contain the following information:

- full name and address of person nominated;
- web home page if any;
- name of particular ICIAM Prize;
- proposed citation (concise statement about the outstanding contribution in fewer than 250 words);
- justification for nomination (cite nominator's reason for considering candidate to be deserving, including explanations of the scientific and practical influence of the candidate's work and publications);
- CV of the nominee;
- name and contact details of the proposer.

The deadline for nominations is 31 October 2013.

Nominations should be sent to the President of ICIAM, Barbara Keyfitz, preferably in electronic form. Nominations will be acknowledged.

ICIAM Prize committee:
Committee chair: Barbara Keyfitz
Donatella Marini (chair of Collatz Prize Subcommittee)

Felix Otto (chair of Lagrange Prize Subcommittee)
Pam Cook (chair of Maxwell Prize Subcommittee)
Takashi Kako (chair of Pioneer Prize Subcommittee)
Philippe Ciarlet (chair of Su Buchin Prize Subcommittee).

ICIAM, the International Council for Industrial and Applied Mathematics, is the world organization for applied mathematics and computational science. Its members are mathematical sciences societies based in more than 20 countries. For more information, see the Council's web page at www.iciam.org.

Monash Mathematicians in the Media

Dr Andrew Prentice featured in a story (with photo and video) about his ideas for how Saturn's largest moon Titan was formed http://www.theage.com.au/national/education/lifting-the-lid-on-a-remote-realm-20130215-2ehpd.html.

Professor Paul Cally was also in the media on with a story about the approaching peak in solar activity http://www.theage.com.au/national/education/the-sun-fires-up-20130308-2fqfq.html.

Dr Jonathan Keith featured in *The Conversation* on 24 January 2013 about how DNA can encode vast amounts of data and could be a future data storage mechanism http://theconversation.edu.au/dna-data-storage-100-million-hours-of-hd-video-in-every-cup-11777.

Launch of the Poincaré Chair, Institut Henri Poincaré

Members may be interested in this initiative, funded by the prize for the Poincaré Conjecture.

The Poincaré Chair owes its creation and its existence for the next five years to the reward the Clay Mathematics Institute (http://www.claymath.org, CMI, Providence, Rhode Island) has reserved for the solution of the Poincaré Conjecture.

The aim of this program, started in January 2013 by the Henri Poincaré Institute (http://www.ihp.fr), is to allow young talented mathematicians to develop their skills in outstanding working conditions... just like Grigori Perelman benefited from a chair from the Miller Institute in Berkeley (California, USA) at the beginning of his career.

This research program of a six-month or one-year duration comes with a generous salary, an ideal mathematical environment in Paris, and no obligations; it is open to all thematics in mathematics.

The objective is to give young researchers on the edge of a promising international career the means to develop deep and audacious research projects, as well as to base their international recognition.

If you have any questions, please email Sylvie Lhermitte (poincarechair@ihp.fr).

For more information http://www.ihp.fr/en/PoincareChair.

Sydney University Association for Women in Mathematics

The newly formed Sydney University Association for Women in Mathematics launched on 21 March with the inaugural talk 'Life and Mathematics: A Personal Journey' by Professor Nalini Joshi (Georgina Sweet Laureate Fellow).

Maths and Stats leaves the Austin Keane Building at Wollongong

Professor Martin Bunder offers some personal reflections on the department's move from long established premises.

The Department of Mathematics, at the then Wollongong University College, moved into the ACS Building as soon as the building was completed early in 1970. Two of the mathematicians, Keith Tognetti and Martin Bunder, who moved in then, are still honorary members of staff. ACS stood for Arts-Commerce-Science and it housed all of Arts (including Education), all of Commerce and about half of Science. Arts and Commerce moved out long ago, as did Computer Science, which grew out of Maths. Thanks to its success at recruiting many locally and externally funded staff, the now School of Mathematics and Applied Statistics will unfortunately be moving from what, since 1983, has been the Austin Keane Building, to an inferior modern building which has more offices. Austin Keane, aged only 37, became the first Professor of Mathematics at Wollongong in 1964, and later the first Deputy Vice Chancellor of the University of Wollongong. He died aged only 52 in 1979. Austin also had the distinction of being the first person to do a PhD in Maths in Australia (there was one earlier one in Statistics). He was a charismatic leader, published prolifically, and successfully supervised 18 PhD and 10 research masters students. In 2007 a permanent display in honour of Austin, designed by Wollongong Creative Arts students, was set up on a ground floor, based on some of his early works on Geometry and beta functions. It is sad to have the connection between Maths and the Austin Keane Building broken. A small link will remain at this stage, through a student computer laboratory, named after former staff member Tom Horner, and the Access Grid room.

Completed PhDs

Australian National University

- Dr Sudi Mungkasi, *A study of well-balanced finite volume methods and refinement indicators for the shallow water equations*, supervisor: Stephen Roberts.

La Trobe University

- Dr Nadiya Aldhamri, *Natural dualities for quasi-varieties of semigroups*, supervisors: Marcel Jackson and Brian Davey.
- Dr Thanh Long Nguyen, *Compatible relations on logic-based algebras*, supervisors: Jane Pithkethly, Narwin Perkal and Brian Davey.

University of Melbourne

- Dr Ben Lansdell, *Understanding Bcl-2 family interactions through computational modelling*, supervisors: Kerry Landman and Terry Speed.
- Dr James Jones, *Characters of p-compact groups*, supervisors: Nora Ganter and Arun Ram.
- Dr Sam Chow, *Analytic and computational approaches to comparing the Fourier coefficients of Hecke eigenforms*, supervisor: Alex Ghitza.

University of Queensland

- Dr Will Probert, *Methods for decision theory in conservation biology*, supervisors: H. Possingham, A. Richardson and P. Baxter.

University of South Australia

- Dr Indu Bala Wadhawan, *Pickup and delivery with queueing*, Supervisors: Peter Pudney and Julia Piantadosi.
- Dr Dale Andrew Ward, *E.D.E.M. extended-domain-eigenfunction method*, supervisors: Stan Miklavcic and Bronwyn Hajek.

University of Southern Queensland

- Dr Osama Ogilat, *Steady and unsteady free surface flow past a two-dimensional stern.* supervisors: Yury Stepanyants and Dmitry Strunin.

University of Sydney

- Dr Jennifer Wilcox, *Some aspects of non parametric maximum likelihood for normal mixtures*, supervisor: Michael Stewart.

University of Western Australia

- Dr Mei Yi Tan, *Analysing human walking behaviour using dynamic optimisation*, supervisors: Leslie Jennings/Winthrop and Song Wang.

University of Wollongong

- Dr Ben Maloney, *Semigroup actions on higher rank graphs and their graph C^*-algebras*, supervisors: David Pask and Iain Raeburn.
- Dr Alexandra Burden, *Zone issues in the analysis of small area health data*, supervisor: David Steel.
- Dr Diane Hindmarsh, *Small area estimation for health surveys*, supervisor: David Steel.
- Dr Jinda Kongcharoen, *Statistical explorations of gene structure and its correlation with gene expression and function*, supervisors: Yan-Xia Lin and Ren Zhang.

Awards and other achievements

Australian National University

- Dr Benjamin Andrews and Professor Andrew Hassell have been elected as Fellows of the Australian Academy of Science and will present summaries of the work for which they have been honoured at the Academy's annual three-day celebration, Science at the Shine Dome, on 29 May in Canberra.
- Alan Carey has been awarded a Hausdorf Institute Trimester Program Grant for 2014.

Flinders University

- Vladimir Gaitsgory has received an ARC Discovery Outstanding Researcher Award (DORA) for the period 2013–2015. He is Sole CI, on a project entitled Construction of near optimal oscillatory regimes in singularly perturbed control systems via solutions of Hamilton–Jacobi–Bellman inequalities.

La Trobe University

- Dr Sarah Johansen has won the The Nancy Millis PhD Excellence Prize awarded by the Faculty of Science, Technology and Engineering at La Trobe University for her thesis *Dualisability of relational structures*.

University of Adelaide

- Tom Brown, who was an AMSI summer scholarship student with Dr Ed Green and Dr Ben Binder, won the best talk prize at the Big Day In back in February for his work on agent-based modelling of cell aggregation in tissue engineering (there's a bit more info about it on the school website, www.maths.adelaide.edu.au/news/news.html).

University of Sydney

- Garth Tarr won the prize for the best student presentation at the Young Statisticians Conference 2013 in February in Melbourne.
- Theodore Vo won the TM Cherry Prize for the best student talk at the ANZIAM 2013 meeting in Newcastle, NSW.
- Darren Engwirda received an honourable mention at the ANZIAM 2013 meeting.
- Clinton Boys received the 2013 Philipp Hofflin International Research Travel Scholarship to travel to the University of Oregon.
- Rebecca Barter received the CSIRO CMIS Honours Scholarship for 2013.

Appointments, departures and promotions

Australian National University

- Dr David Smyth was appointed as Lecturer on 16 January 2013.

Flinders University

- Professor Vladimir Gaitsgory joined the School of Computer Science, Engineering and Mathematics at Flinders as a DORA Fellow. His research program will complement the activities of the Flinders Mathematical Sciences Laboratory. Vladimir is an applied mathematician with broad areas of interest in control, optimisation (operations research), dynamical systems and games theories, and their applications. His most important contributions are in the areas of singularly perturbed (SP) Markov decision processes and mathematical programming problems and in the area of SP dynamical control systems. He has authored and co-authored three research monographs and numerous papers. He has attracted a significant ARC funding to support his research.

RMIT

- In March 2013, Professor Lewi Stone joined the School of Mathematical and Geospatial Sciences as a research and innovation professor. Professor Stone comes from Tel-Aviv University, Israel, where he spent over two decades. Originally from Melbourne, Lewi Stone studied at Monash University where he obtained an Honours degree in mathematics followed by a PhD. Professor Stone has published several papers in *Nature*. Twenty-five of his numerous papers since 1995 have been cited at least 25 times (i.e. Scopus h-index = 25).He has research interests in nonlinear dynamics and biomathematics (mainly epidemiology). More details can be found at http://www.tau.ac.il/lifesci/zoology/members/lewi.htm. Professor Stone will also provide leadership to the Network Modelling Group within the Platform Technologies Research institute of RMIT University.
- Dr Kristine Lally recently resigned from RMIT Mathematics to take up an on-line teaching position in Sweden.

University of Adelaide

- Dr Joshua Ross has been promoted to Senior Lecturer.
- Matt Roughan has been promoted to Professor.
- Dr Luke Bennetts has been appointed as Lecturer in Applied Mathematics.
- Dr Ed Green has been appointed as Lecturer in Applied Mathematics.
- Dr Giang Nguyen has been appointed as Lecturer in Applied Mathematics.
- Dr Danny Stevenson has been appointed as Senior Lecturer in Pure Mathematics.

University of Melbourne

- Dr Kevin Tatur (Research Fellow) has left the University.

University of New England

- Dr Peter Dillingham joined the Discipline of Mathematics and Statistics as Lecturer in Statistics.

UNSW Canberra

- Dr Joanne Chapman (Lecturer in Statistics) left the School of Physical, Environmental and Mathematical Sciences in February 2013.

University of South Australia

- Dr Bronwyn Hajek has been appointed as Lecturer (level B, continuing) in the School.

University of Sydney

- Dr Martina Chirilus-Bruckner and Dr Andrew Papanicolaou have accepted fixed-term lectureships in Applied Mathematics and will commence in July 2013.

University of Tasmania

- Yuliya Karpievitch has joined the University.
- Des FitzGerald retired on 31 January 2013.

University of Western Australia

- John Lau has been promoted from Assistant Professor to Associate Professor.

University of Wollongong

- Dr Jiakun Liu, previously a Simons Fellow at Princeton, has joined the school as a Lecturer.
- Dr Adam Sorensen, of the University of Copenhagen, has arrived at UOW recently. He will be here for two years, funded by a Danish Research Council fellowship, to work on operator algebras associated to graphs.

New Books

Flinders University

- Borkar, V.S., Ejov, V., Filar, J.A. and Nguyen, G.T. (2012). *Hamiltonian Cycle Problem and Markov Chains*. Springer, New York.

Conferences and Courses

Conferences and courses are listed in order of the first day.

Analysing Random Events on a Network

Date: 17 May 2013 (2.00pm WST, 4.00pm EST)
Venue: University of Western Australia
Web: http://www.amsi.org.au/index.php/events-mainmenu/agr-events

Speaker: Professor Adrian Baddeley (CSIRO and University of Western Australia).

Spatial patterns of events that occur on a network of lines, such as traffic accidents recorded on a street network, present many challenges to a statistician. How do we know whether a particular stretch of road is a 'black spot', with a higher-than-average risk of accidents? How do we know which aspects of road design affect accident risk? These important questions cannot be answered satisfactorily using current techniques for spatial analysis. The core problem is that we need to take account of the geometry of the road network. Standard methods for spatial analysis assume that 'space' is homogeneous; they are inappropriate for point patterns on a linear network, and give fallacious results. To make progress, we must abandon some of the most cherished assumptions of spatial statistics, with far-reaching implications for statistical methodology.

The talk will describe the first few steps towards a new methodology for analysing point patterns on a linear network. Ingredients include stochastic processes, discrete graph theory and classical partial differential equations as well as statistical methodology. Examples come from ecology, criminology and neuroscience.

Incremental Network Design

Date: Tuesday 28 May 2013, 2.30pm EST
Venue: University of Newcastle
Web: http://www.amsi.org.au/index.php/events-mainmenu/agr-events

Speaker: Professor Martin Savelsbergh (University of Newcastle).

Network infrastructures are a common phenomenon. Network upgrades and expansions typically occur over time due to budget constraints. We introduce a class of incremental network design problems that allow investigation of many of the key issues related to the choice and timing of infrastructure expansions and their impact on the costs of the activities performed on that infrastructure. We examine three variants: incremental network design with shortest paths, incremental network design with maximum flows, and incremental design with minimum spanning trees. We investigate their computational complexity, we analyze the performance of natural heuristics, we derive approximation algorithms, and we study integer program formulations.

Algebraic geometry and related fields

Date: 29–31 May 2013
Venue: Australian National University, Canberra
Web: http://maths-people.anu.edu.au/~alperj/anu-algebraic-geometry.html

This local workshop will cover fields related to algebraic geometry, such as geometric representation theory, arithmetic algebraic geometry, and K-theory. If you're interested, please register at the website.

All are welcome.

Workshop: Optimisation in Industry

Date: 3–5 June 2013
Venue: Swanston Academic Building, 445 Swanston St, Melbourne
Web: http://optimisationinindustry.com

This three-day event will bring together graduate students, researchers and industry practitioners with an interest in solving industrial problems using mathematical programming techniques and algorithms.

The focus of the workshop will be on industrial problems solved successfully. The talks will clearly define the problems that had to be solved, explain their difficulty, and expose the solution 'path' (with failures and successes), concluding with the delivered product. We will also discuss how real-world problems are approached: how does one get from the initial discussions and data to a full solution and a happy customer?

Organisers
Professor Andrew Eberhard, RMIT, AMSI and AustMS Member
Professor Peter Taylor, University of Melbourne, AMSI and AustMS Member
Dr Heng-Soon Gan, University of Melbourne, AMSI Member
Dr Irina Dumitrescu, IBM Research — Australia

Cost
AMSI Members and AustMS Members: regular \$150, earlybird \$110.
AMSI Students from member universities and AustMS student membership: regular \$90, earlybird \$60
Non-member: \$200/\$150
Day registration: \$100

FYiMaths Workshop: Building a Network

Date: 10am to 5pm, Friday 21 June 2013
Venue: University of Melbourne, Parkville

An invitation to all academics teaching first year mathematics.

First Year in Maths (FYiMaths) is an Office of Learning and Teaching funded project involving the University of Melbourne, University of Adelaide, Curtin University and University of Sydney. The project aims to build a vibrant network of academics teaching in first year mathematics.

This workshop will be the first step in establishing the network. The purpose of this workshop is to

- Introduce the project and its aims
- Engage academics working in first year mathematics in discussion on the issues important to them and provide opportunities for networking across institutions
- Provide professional development that focuses on enhancing the importance of first year mathematics and improving understanding of new initiatives in tertiary teaching in areas such as assessment, research and publishing

The workshop is for any academic staff teaching, coordinating or directing first-year units and programs. The workshop is free and includes lunch and refreshments.

Program overview

9.30–10.00	Registration and Coffee
10.00–10.15	Welcome and Introductions: Dr Deborah King
10.15–10.30	Overview of the project and workshop
10.30–12.00	Group discussion (includes morning tea) • Identifying the key issues in first year mathematics
12.00–12.45	Evaluating the effectiveness of your teaching • Speaker to be confirmed
12.45–1.45	Lunch
1.45–3.15	MathsAssess — Assessment Workshop • A practical session conducted by Assoc. Prof. Cristina Varsavsky
3.15–3.45	Afternoon tea
3.45–4.30	ACDS Teaching and Learning Centre • Presentation by Assoc. Prof. Elizabeth Johnson
4.30–5.00	Networking and promoting your role • Presentation by Assoc. Prof. Manjula Sharma

To register your attendance or if you have any questions, please email Joann Cattlin (joann.cattlin@unimelb.edu.au) or call (03) 9035 8694.

About the project
This project is investigating the challenges facing academics who have some role in coordinating or managing first-year maths programs. It will examine and promote the role of first year program and subject coordinators and education specialists, and build leadership capacity by identifying characteristics of a national first year culture, providing professional development opportunities, mentorship and best or outstanding practices and support mechanisms. It will articulate the roles of first year coordinators and educators, including expectations, responsibilities and the capabilities required to effectively lead and manage complex programs of mathematical study within the diversities of degree programs including engineering, science and commerce. The outcomes of this project will provide guidance to educators at the coalface and inform tertiary departmental and faculty decision making.

The project team is Dr Deb King (University of Melbourne), Dr Adrian Koerber (University of Adelaide), Professor Jo Ward (Curtin University) and Assoc. Professor Leon Poladian (University of Sydney) and Joann Cattlin (University of Melbourne). The project commenced in November 2012.

8th Annual AMSI Winter School

Date: 24 June to 5 July 2013
Venue: University of Queensland
Web: www.amsi.org.au/WS13.php
Contact: winterschool@math.uq.edu.au

The 8th Annual AMSI Winter School is designed for postgraduate students and postdoctoral fellows in the mathematical sciences and cognate disciplines. The aim of the School is to enable participants to deepen their mathematical knowledge, and to broaden the potential for applying their mathematical knowledge.

This year's Winter School offers a number of mini-courses relating to the theme Mathematics of Planet Earth. Mini-courses in the first week are Numerical methods on GPUs, Large-scale inversion for geophysical exploration, and Dynamical systems and singular perturbation. Building on these, the second week offers mini-courses on mathematical modelling of infectious diseases, regularization of inverse problems in geomathematics, and optimisation for nature conservation.

The mini-courses will be delivered by world-leading researchers, providing a rich learning experience for postgraduate students and early-career researchers. It is also an opportunity for participants to make valuable connections with their peers at other institutions.

Category Theory 2013

Date: 7–13 July 2013
Venue: Macquarie University
Web: http://web.science.mq.edu.au/groups/coact/seminar/ct2013

Talks in areas closely related to category theory are welcome. The deadline for abstract submission is 1 May.

The deadline for the early bird rate for registration is 17 May.

This conference will be preceded by an AMSI-funded workshop on Applications of Category Theory, which is intended especially for graduate students an early career researchers.

More information about both can be found at the conference website.

Please email Steve Lack (steve.lack@mq.edu.au) to receive further announcements.

The 2013 Genetics Society of AustralAsia conference

Date: 14–17 July 2013
Venue: University of New South Wales
Web: http://conference2013.genetics.org.au

There will be a Mathematics of Planet Earth session whose focus is on Mathematical and Computational Genetics. Prof. Michael Turelli (University of California, Davis) will deliver the plenary for this session.

Michael Turelli is Distinguished Professor of Genetics at the University of California, Davis. He holds the Joel Keizer Endowed Chair in Theoretical and Computational Biology, and is affiliated with the Center for Population Biology and the Department of Ecology and Evolution at UC Davis. His research interests lie in theoretical population and quantitative genetics, speciation, and the population and evolutionary biology of Wolbachia and its hosts, especially Drosophila and disease-vector mosquitoes. His work on Wolbachia-induced cytoplasmic incompatibility is being applied in an attempt to control the spread of dengue fever (see Barton and Turelli 2011; Hoffmann *et al.* 2011). Professor Turelli has a background in mathematics (BS, UC Riverside) and biomathematics (PhD, University of Washington). He is an Elected Fellow of the American Academy of Arts and Sciences (2005). He was awarded a Guggenheim Fellowship (1986–1987) and the Miller Research Professorship at UC Berkeley (2006), and was the UC Davis Academic Senate Faculty Research Lecturer in 2012.

Registration is now open at http://conference2013.genetics.org.au/call-for-abstracts, and early-bird registration closes on Monday 13 May.

In addition to a program that will span the breadth of the extraordinary genetic research being conducted in Australia and around the world, there will be two workshops held on Sunday 14 July.

- Simon Ho from the University of Sydney will run a workshop on BEAST.
- Rod Peakall from the The Australian National University will run a workshop on GenAlEx: Genetic Analysis in Excel.

See http://conference2013.genetics.org.au/workshops for more information.

Charles Pearce Memorial Symposium

Date: 17 June 2013
Venue: School of Mathematical Sciences, University of Adelaide
Web: www.maths.adelaide.edu.au/PearceSymposium.html

This Symposium is to honour the life and work of the Elder Professor of Mathematics, Professor Charles Edward Miller Pearce. Tragically, Charles died in New Zealand on 8 June 2012. Charles was internationally known for his work on probabilistic and statistical modelling, and analysis, and he published over 300 research articles. He also successfully supervised 30 PhD students.

The program will consist mainly of technical talks, but there will also be the opportunity for brief personal comments/recollections to be shared about Charles.

Please visit the website for the details of the Symposium. Registration for the symposium is free, and is to be conducted through this webpage.

We also will organise a dinner in the evening (which will be at your own cost).

IGA/AMSI Workshop, Representation Theory and Operator Algebras

Date: 1–5 July 2013
Venue: University of Adelaide, North Terrace Campus
Web: www.iga.adelaide.edu.au/workshops/WorkshopJuly2013

This interdisciplinary workshop will be about aspects of representation theory (in the sense of Harish-Chandra), aspects of noncommutative geometry (in the sense of Alain Connes) and aspects of operator K-theory (in the sense of Gennadi Kasparov). It features the renowned speaker, Professor Nigel Higson (Penn State University).

Category Theory

Date: 7–13 July 2013
Venue: Macquarie University
Web: http://web.science.mq.edu.au/groups/coact/seminar/ct2013/

Australia New Zealand Applied Probability Workshop

Date: 8–11 July 2013
Venue: University of Queensland
Web: www.smp.uq.edu.au/people/YoniNazarathy/AUSTNZworkshop/2013/main.html

Organisers: Nigel Bean, Jeff Hunter, Dirk Kroese, Yoni Nazarathy, Phil Pollett, Leonardo Rojas-Nandayapa, Joshua Ross, Peter Taylor and Ilze Zidenis.

The scope includes stochastic financial models, queueing theory, actuarial science, stochastic biological models, Monte Carlo methods, inference for stochastic models, general applied probability and related fields and applications.

MPE Australia 2013

Date: 8–12 July 2013
Venue: Rydges Hotel, 186 Exhibition Street, Melbourne
Web: www.MoPE.org.au/events/2013

An MPE partner and Australian Academy of Science Elizabeth and Frederick White Conference.

The MPE Australia Conference is the key scientific event for this year's Mathematics of Planet Earth Australia program. The themes covered over the week will include earth system modelling, scientific data mining, mitigating natural disaster risk, bioinvasion and biosecurity; we will focus on how the mathematical sciences can be utilised to address the challenges faced by our planet.

To submit your abstract, go to the website above. Abstract submission closes at 5pm on Friday 31 May 2013.

For more information see the website, or see *Gazette* 40(1), pp. 72–73.

Eco-Stats Symposium: New Opportunities at the Interface between Ecology and Statistics

Date: 11–12 July 2013
Venue: University of New South Wales, Sydney
Web: www.eco-stats.unsw.edu.au/symposium.html

GAIA 2013: AMSI/AustMS Workshop on General Algebra and its Applications

Date: 15–19 July 2013
Venue: La Trobe University Franklin Street campus, Melbourne
Web: www.latrobe.edu.au/city
Email: GAIA2013@latrobe.edu.au

A conference in honour of Brian Davey's retirement and 65th birthday.

The main theme of the conference is universal algebra, its applications and neighbouring disciplines. This includes, but is not limited to, orders and lattices, semigroups, algebraic logic and model theory, algebraic methods in computer science, and so on.

Important dates
Abstract submission is now closed.

Registration (now open)
Standard registration AU$300, date 31 May, AU$350 after 31 May.
Student registration AU$100, date 31 May, AU$150 after 31 May.
AustMS/AAMSI member AU$210 date 31 May, AU$260 after 31 May.

Plenary speakers

- Libor Barto (Charles University)
- Andrei Bulatov (Simon Fraser University)
- David Clark (SUNY New Paltz)
- Igor Dolinka (University of Novi Sad)
- Peter Jipsen (Chapman University)
- Marcin Kozik (Jagiellonian University)
- Andrei Krokhin (Durham University)
- Miklos Maroti (Bolyai Institute)
- Ralph McKenzie (Vanderbilt University)
- Hilary Priestley (Oxford University)
- Mikhail Volkov (Ural Federal University)
- Ross Willard (Waterloo University)

The program will consist of talks from plenary speakers as well as shorter contributed talks. If you wish to present a contributed talk, please submit your abstract via the website by 19 April.

There will be a special edition of *Algebra Universalis* in honour of Brian Davey's 65th birthday and the conference.

Organising Committee
James East (University of Western Sydney), Marcel Jackson (La Trobe University), Tomasz Kowalski (La Trobe University), George McNulty (University of South Carolina), Todd Niven (La Trobe University).

Australian Mathematical Sciences Student Conference

Date: 15–17 July 2013
Venue: Australian National University
Web: http://maths.anu.edu.au/events/australian-mathematical-sciences-student-conference

The goal of the Australian Mathematical Sciences Student Conference is to bring together postgraduate and honours students in the mathematical sciences from around Australia, enabling them to communicate their work, facilitating dialogue, and encouraging collaboration, all in a friendly and informal atmosphere.

For more information, please visit the website.

First International Conference on Creative Mathematical Sciences Communication 2013 Theme: Computer Maths-Curiosity, Art, Story

Date: 2–5 August and 6–10 August 2013
Venue: Charles Darwin University
Web: www.cdu.edu.au/conference/csmaths

For more information see the website, or see *Gazette* 40(1), p. 73.

Annual Conference of the Australian Mathematical Society

Date: 30 September – 3 October 2013
Venue: University of Sydney
Web: www.maths.usyd.edu.au/u/austms2013

Registration is now open. Please visit the website.

DELTA 2013

Date: 24–29 November 2013
Venue: The Pavillion, Kiama, NSW
Web: www.delta2013.net

For further details visit the website, or see *Gazette* 40(1), p. 74.

EMAC 2013: 16th Engineering Mathematics and Applications Conference

Date: 1–4 December 2013
Venue: Queensland University of Technology, Brisbane
Web: www.emac2013.com.au

Registration is now open; abstracts can also now be submitted. As with other recent EMAC conferences, presenters will again be able to submit papers (following the conference conclusion) for refereeing and possible inclusion in the electronic supplement of the *ANZIAM Journal*.

The website for the conference has recently been updated and includes information such as currently confirmed keynote speakers, registration costs, student support schemes and other important information.

MODSIM2013: International Congress on Modelling and Simulation

Date: 1–6 December 2013
Venue: Adelaide Convention Centre, South Australia
Web: http://mssanz.org.au/modsim2013

Due to a large number of requests, the Organising Committee has decided to extend the deadline for submission of abstracts until 30 April 2013.

Please note that everyone is required to submit a brief abstract (max 250 words) by 30 April. Once your abstract has been accepted you will have the option of writing an extended abstract or a full paper of up to seven pages. The deadline for submission of extended abstracts and full papers is 8 July, 2013. To submit an abstract for MODSIM2013 go to mssanz.org.au/rego. Click on 'Log In'. Click on 'Not a user? Create an account with this site'. Choose 'International Congress on Modelling and Simulation (MODSIM)'. Choose 'MODSIM 2013'. Fill in the form, and the most important step is to click the 'Author' checkbox near the bottom. Submit an abstract!

37ACCMCC: 37th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing

Date: 9–13 December 2013
Venue: University of Western Australia
Web: http://37accmcc.wordpress.com
Contact: Director: Professor Gordon Royle (37accmcc at uwa.edu.au)

Invited speakers include:

- Matt DeVos (Simon Fraser University)
- Graham Farr (Monash University)
- Bill Martin (Worcester Polytechnic Institute)
- Dillon Mayhew (Victoria University of Wellington)
- Primož Potočnik (University of Ljubljana)
- Dana Randall (Georgia Institute of Technology)
- Tamás Szonyi (Eötvös Loránd University)
- Nick Wormald (Monash University)

Vale

Associate Professor Neil Cameron

We are sadddened to report the passing on 30 March 2013 of Associate Professor Neil Cameron, who was Head of the (then) Department of Mathematics & Statistics prior to his retirement in December 1997. A memorial service for Neil will be held in the Religious Centre (Building 9) at the Clayton campus at Monash University at 3 pm on Thursday 9 May 2013. All members of the mathematical community are invited to attend.

Neil was known across Monash for his tireless work with students and colleagues at department, faculty and university level, as well as in the halls of residence and beyond the university. He will also be remembered as an able administrator — indeed, he was one of the first Associate Deans, being AD (Teaching) in the Faculty of Science. Along with his wife Annette, he always took a very active interest in student development. In a number of cases they assisted and cared for individual students, and guided them through their studies.

Neil had a rich academic career in mathematics and a genuine interest in student education and welfare.

A full obituary will appear in later issue of the *Gazette*.

Visiting mathematicians

Visitors are listed in alphabetical order and details of each visitor are presented in the following format: name of visitor; home institution; dates of visit; principal field of interest; principal host institution; contact for enquiries.

Marzieh Akbari; K.N. Toosi University of Technology, Iran; 1 March to 1 October 2013; –; UWA; Cheryl Praeger

Dr Tomoyuki Arakawa; Kyoto University; 15 April to 15 May 2013; pure; USN; Alexander Molev

Dr Tarje Bagheer; University of Copenhagen, Denmark; 14 February 2012 to 13 February 2014; –; UMB; Craig Westerland

Dr Peter Blennerhassett; University of New South Wales; 25 April to 17 May 2013; –; UWA; Andrew Bassom

Dr Mark Blyth; University of East Anglia; 4–22 August 2013; –; UWA; Andrew Bassom

Dr Chris Bowman; –; 1 to 21 May 2013; pure; USN; Andrew Mathas

Toralf Burghoff; University Jena, Germany; 2 April 2013 to 31 March 2014; –; UOM; Kostya Borovkov

Dr Yukun Cheng; Zheijiang University, PRC; 1 August 2012 to 31 July 2013; –; UMB; Sanming Zhou

Dr Kevin Coulembier; Ghent University; 16 January to 7 May 2013; pure; USN; Ruibin Zhang

Prof Naihuan Jing; North Carolina State University; 13 May to 13 June 2013; pure; USN; Alexander Molev

Dr Paul Kabaila; La Trobe University; 21 January to 21 June 2013; –; UMB; Geoff Prince/Peter Hall

Dr Lingzhou; Yangzhou University, China; 26 March to 25 September 2013; nonlinear PDE; UNE; Yihong Du

Michel Mandjes; University of Amsterdam; March to June 2013; applied probability; UQL; Dirk Kroese and Yoni Nazarathy

Paul Mortimer; Queen Mary University, London; 4 April to 11 May 2013; –; UMB; Aleks Owczarek

Dr Kok Haur Ng; University of Malaya; 1 February to 31 May 2013; stats; USN; Shelton Peiris

Xiao-Long Peng; Shanghai University; July 2012 to June 2013; –; UWA; Michael Small

Dr Balakrishna Prabhu; Laboratoire d'Analyse et d'Architecture des Systemes, Toulouse; 24 June to 13 July 2013; applied probability, telecommunications networks; UQL; Phil Pollett

Dr Piotr Pusz; Rzeszow University, Poland; 29 April to 10 May 2013; mathematical models in economy; FDU; –

Prof David Roberts; University of Minnesota; 10 June to 10 July 2013; MAGMA; USN; John Cannon

Werner Scheinhardt; University of Twente; June to July 2013; applied probability; UQ; Dirk Kroese and Yoni Nazarathy

Ms Maryam Siddiqa; University Lahore; November 2012 to June 2013; –; UWA; –

Bimal Sinha; University of Maryland; 27–29 May 2013; applied statistics; UWA; –

Dr Robert Smith?; University of Ottawa; 17 June 2013 to 30 July 2013; disease modelling; UNSW Canberra; Geoff Mercer

Xiaoran Sun; Harbin Institute of Technology; October 2012 to September 2013; –; UWA; Michael Small

Sara Taskinen; University of Jyväskylä, Finland; January to December 2013; robust multivariate analysis and applications in ecology; UNSW; David Warton

Mr Jonas Teuwen; TU Delft; 04 February 2013 to 31 Auguts 2013; analysis and geometry; ANU; Pierre Portal

Mr Thomas Trogdon; –; 28 April to 12 May 2013; applied; USN; Sheehan Olver

Prof Mingxin Wang; Harbin Institute of Technology, China; 26 March to 30 May 2013; nonlinear PDE, UNE; UNE; Yihong Du

Prof Anthony Weston; Canisius College, New York; 15 April to 30 June; functional analysis; UNSW; Ian Doust

Mr Wei Wu; UNSW; 30 July 2012 to 30 June 2015; financial maths; USN; Ben Goldys

Binzhou Xia; Peking University; 1 September 2012 to 20 March 2014; –; UWA; Cai Heng Li

Ms Ting Zhang; University of Science and Technology, China; 1 September to 31 August 2013; applied and nonlinear analysis program; ANU; Xu-Jia Wang

Assoc Prof Jin-Xin Zhou; Beijing Jiaotong University; 16 November 2013 to 16 November 2014; UWA; Cai Heng Li

Fantastic prizes to be won!

Mathematics of Planet Earth 2013 AUSTRALIA

Limitless applications

Join hundreds of scientific societies, universities, research institutes, and organisations all over the world as we band together to dedicate 2013 as the year for Mathematics of Planet Earth.

There's lots of ways you can get involved!

- Write a blog
- Photo competition
- Workshops
- Puzzles & code breaking
- School activities
- Public lectures

What's on?

29 Jan	MPE Australia Launch & Simons Public Lecture
14 Mar	International Pi Day
19–21 Jun	Mathematics of Transportation Networks Workshop, Monash University
8–12 Jul	MPE 2013 conference
10–18 Aug	Science Week
13–19 Oct	Earth Science Week
11–12 Dec	Limits to Growth: Beyond the point of inflexion

Find out more: www.MoPE.org.au/events

Election of Officers and Ordinary Members of Council

Officers of Council

Nominations are invited for the following two Officers for the session commencing after the Annual General Meeting to be held in October 2013: one Vice-President and one President-Elect.

Note: According to Paragraph 34(i) of the AustMS Constitution, after the AGM in October 2013, Professor P.J. Forrester will continue in office as the President, and Professor P.G. Taylor steps down as Immediate-Past-President, and is not eligible for immediate re-election as a Vice-President.

According to Paragraph 34(ii), Professor K.A. Smith-Miles steps down as Elected Vice-President, and is not eligible for immediate re-election to that office.

According to Paragraph 34(iii), the positions of Secretary and Treasurer will be appointed by Council at its September 2013 meeting.

The present Officers of the Society are:
President: P.J. Forrester
Immediate-Past-President: P.G. Taylor
Vice-President: K.A. Smith-Miles
Secretary: P.J. Stacey
Treasurer: A. Howe

Ordinary Members of Council

The present elected Ordinary Members of Council are:

1. Members whose term of office expires after the AGM in October 2013
   F. Larusson
   M. O'Reilly
2. Members whose term of office expires after the AGM in December 2014
   J. Bamberg
   N. Boland
   A.R. Francis
3. Members whose term of office expires after the AGM in September 2015
   J. Filar
   A. Glen
   D. Mallet

Accordingly, nominations are invited for two positions as Ordinary Members of Council, who shall be elected for a term of three consecutive sessions. Note that according to Paragraph 34(iv) of the Constitution, F. Larusson and M. O'Reilly are not eligible for re-election at this time as Ordinary Members. Paragraph 35 of the Constitution requires that the elected Officers and elected members of Council shall include residents from all the States and the ACT. Accordingly, nominations for the two Officers and two Ordinary Members must include a member from Tasmania, to satisfy this.

To comply with the Constitution (see Paragraphs 61 and 64), all nominations should be signed by two members of the Society and by the nominee who shall also be a Member of the Society.

Nominations should reach the Secretary (whose name and address appear inside the back cover of the *Gazette*) no later than *Friday 21 June 2013*.

Alternatively, members are encouraged to send informal suggestions to the Nominations and Publications Committee, by emailing the Secretary at Secretary@austms.org.au.

For the information of members, the following persons are presently *ex-officio* members of Council for the Session 2012–2013.

Vice President (Chair of ANZIAM):	P. Broadbridge
Vice President (Annual Conferences):	S.O. Warnaar
Representative of ANZIAM:	J. Piantadosi
Public Officer of AustMS and AMPAI:	P.J. Cossey
Chair, Standing Committee on Mathematics Education:	L. Wood
AustMS member elected to Steering Committee:	N. Joshi

Editors: S.A. Morris and D.T. Yost (Gazette)
G.L. Cohen (Bulletin)
R.R. Moore (Electronic Site)
J.M. Borwein and G.A. Willis (Journal of AustMS)
C.E. Praeger (Lecture Series)
A.P. Bassom and G. Hocking (ANZIAM Journal)
A.J. Roberts (ANZIAM Journal Supplement)

The Constitution is available from the Society's web pages, at http://www.austms.org.au/Constitution

The 2014 ANZIAM Medal: call for nominations

Nominations are now sought for the ANZIAM Medal, which is the premier award of ANZIAM, a division of the Australian Mathematical Society.

Closing date: 8 November 2013.

Nominations for the Award can be made by any member of ANZIAM other than the nominee. A nomination should consist of a brief CV of the nominee together with the nominee's list of publications and a one-page resume of the significance of the nominee's work. Nominations should be forwarded in confidence, electronically, to the Chair of the Selection Panel, Dr Robert Anderssen (Bob.Anderssen@csiro.au).

Further details of the application process and the award criteria are on the ANZIAM website: www.anziam.org.au/The+ANZIAM+medal.

The 2014 J.H. Michell Medal: call for nominations

Nominations are now sought for the J.H. Michell Medal, an award given in honour of John Henry Michell, by ANZIAM, a division of the Australian Mathematical Society. The award is for outstanding new researchers in applied and/or industrial mathematics.

Closing date: 8 November 2013.

Nominations for the Award can be made by any member of ANZIAM other than the nominee. A nomination should consist of a brief CV of the nominee together with the nominee's list of publications and a one-page resume of the significance of the nominee's work. Nominations should be forwarded in confidence, electronically, to the Chair of the Selection Panel, Associate Professor Mary Myerscough (marym@maths.usyd.edu.au).

Further details of the application process and the award criteria are on the ANZIAM website: www.anziam.org.au/The+JH+Michell+Medal.

AustMS support for Special Interest Meetings

Applications are now considered twice a year, at the start of June and the start of December. For 2013, closing dates are 5 June and 4 December.

If funding is being sought from both AustMS and AMSI, a single application should be made at http://www.amsi.org.au/component/content/article/881.

If funding is not being sought from AMSI, please use the application form available at http://www.austms.org.au/Special+Interest+Meetings and send it to the secretary at Secretary@austms.org.au.

AustMS Accreditation

Dr Peter Hochs of the University of Adelaide and Dr Tony Scoleri of DSTO have been accredited as an Accredited Members (MAustMS).

Peter Stacey
AustMS Secretary
Email: P.Stacey@latrobe.edu.au

Peter Stacey joined La Trobe as a lecturer in 1975 and retired as an associate professor at the end of 2008. Retirement has enabled him to spend more time with his family while continuing with some research and some work on secondary school education. He took over as secretary of the Society at the start of 2010.

The Australian Mathematical Society

President:	Professor P.J. Forrester	Department of Mathematics and Statistics University of Melbourne Vic 3010, Australia. p.forrester@ms.unimelb.edu.au
Secretary:	Dr P. Stacey	Department of Mathematics and Statistics La Trobe University Bundoora, VIC 3086, Australia. P.Stacey@latrobe.edu.au
Treasurer:	Dr A. Howe	Department of Mathematics Australian National University ACT 0200, Australia. algy.howe@maths.anu.edu.au
Business Manager:	Ms May Truong	Department of Mathematics Australian National University ACT 0200, Australia. office@austms.org.au

Membership and Correspondence

Applications for membership, notices of change of address or title or position, members' subscriptions, correspondence related to accounts, correspondence about the distribution of the Society's publications, and orders for back numbers, should be sent to the Treasurer. All other correspondence should be sent to the Secretary. Membership rates and other details can be found at the Society web site: www.austms.org.au.

Local Correspondents

ANU:	K. Wicks
Aust. Catholic Univ.:	B. Franzsen
Bond Univ.:	N. de Mestre
Central Queensland Univ.:	*Vacant*
Charles Darwin Univ.:	I. Roberts
Charles Sturt Univ.:	P. Charlton
CSIRO:	C. Bengston
Curtin Univ.:	J. Simpson
Deakin Univ.:	L. Batten
Edith Cowan Univ.:	U. Mueller
Flinders Univ.:	R.S. Booth
Griffith Univ.:	A. Tularam
James Cook Univ.:	S. Belward
La Trobe Univ.:	B. Davey
Macquarie Univ.:	R. Street
Monash Univ.:	A. Peres
Murdoch Univ.:	M. Lukas
Queensland Univ. Techn.:	G. Pettet
RMIT Univ.:	Y. Ding
Swinburne Univ. Techn.:	J. Sampson
Univ. Adelaide:	T. Mattner
Univ. Ballarat:	D. Yost
Univ. Canberra:	P. Vassiliou
Univ. Melbourne:	B. Hughes
Univ. Newcastle:	J. Turner
Univ. New England:	G. Schmalz
Univ. New South Wales:	C. Tisdell
Univ. Queensland:	H.B. Thompson
Univ. South Australia:	K. White
Univ. Southern Queensland:	T. Langlands
Univ. Sunshine Coast:	P. Dunn
Univ. Sydney:	P. Kim
Univ. Tasmania:	B. Gardner
Univ. Technology Sydney:	E. Lidums
Univ. Western Australia:	T. Blackwell
Univ. Western Sydney:	R. Ollerton
Univ. Wollongong:	J. McCoy
UNSW Canberra:	H. Sidhu
Victoria Univ.:	A. Sofo

Publications

The Journal of the Australian Mathematical Society

Editors: Professor J.M. Borwein and Professor G.A. Willis
School of Mathematical and Physical Sciences
University of Newcastle, NSW 2308, Australia

The ANZIAM Journal

Editor: Professor A.P. Bassom
School of Mathematics and Statistics
The University of Western Australia, WA 6009, Australia

Editor: Associate Professor G.C. Hocking
School of Chemical and Mathematical Sciences
Murdoch University, WA 6150, Australia

Bulletin of the Australian Mathematical Society

Editor: Associate Professor Graeme L. Cohen
Department of Mathematical Sciences
University of Technology, Sydney, NSW 2007, Australia

The *Bulletin of the Australian Mathematical Society* aims at quick publication of original research in all branches of mathematics. Two volumes of three numbers are published annually.

The Australian Mathematical Society Lecture Series

Editor: Professor C. Praeger
School of Mathematics and Statistics
The University of Western Australia, WA 6009, Australia

The lecture series is a series of books, published by Cambridge University Press, containing both research monographs and textbooks suitable for graduate and undergraduate students.

ISSN: 0311-0729

Published by The Australian Mathematical Publishing Association Incorporated
Typeset in Australia by TechType, ACT
Printed in Australia by Union Offset Printers, ACT