NeMeSiS News 2015

Newsletter of the

ANU-AAMT National Mathematics Summer School

Mirë se vjen!

Welcome to the 17th edition of NeMeSiS News! We hope that you enjoy reading it. Please let me know what you think.

I am always looking for contributions for NeMeSiS News, so please email me with any feedback, ideas or submissions that you may have. I would love to hear from you!

Merryn Horrocks (editor)

newsletter@nmss.edu.au

NMSS for Teachers

Every January, selected students head on down to Canberra for 2 weeks of "Nerd Camp", as my students have previously called it.

Being a self-confessed nerd, when they offered 'NMSS for Teachers' I was keen to be a part of it.

However, when I got there I found that I had misunderstood the purpose of the Teachers event. The organisers are concerned that there are a lot of schools in Australia that don't know about the student program and that if teachers came and saw what went on, they would be better able to "sell" the event to their students (and school). As a result, the teachers come and view what goes on.

The first night was an introduction. The second day we were treated in 3 hours to the work that the students had been doing over the past week – this was fun, partly due to the presenter, Terry Gagen, and the fact that it is cool to get back and learn (or re-learn) Number Theory.

The organisers saw this as an exercise to get the teachers to see what the students are being taught, but for me it was fantastic to be learning some mathematics, especially topics not designed to boost marks in the HSC.

The teachers also sat in on some of the student lectures. These were dynamic and engaging, and as a teacher it was easy to relax and get involved in quality teaching and learning.

We had the opportunity to mix and chat with the staff and the students on a social basis. We were encouraged to get their take on the program.

I do hope there will be a chance for teachers to have their own "Nerd Camp" where they can spend time learning or relearning topics in mathematics, but in the mean time if you have the opportunity to come down, (even if to only check up on your students) it is a very enjoyable and rewarding few days.

Patrick Parker

As an ex-student returning to NMSS as a visiting teacher, I saw that little has changed. What was new for me, however, was a realisation that the students of NMSS possess a remarkable resilience, both personal and intellectual, that comes from a genuine love of what they are studying. Also, the tutors demonstrate the kind of pedagogy that teachers aspire to - collaboration, rigour and, most of all, an enthusiasm for their subject. I look forward to bringing the spirit of NMSS back to the classroom

Marshall Ma

NMSS SUPPORT

Thank you to everyone who supported NMSS last year - every single dollar helps! I would especially like to thank those alumni who each donated $1000 or more and hope that more alumni who are in a position to help us with such amounts will contribute this year.

I have been working hard to reduce costs and I'm really pleased to announce that next year the cost to attend NMSS will be reduced from $1400 per student to $1200. We still have quite a way to go to be competitive with other similar activities.

Airfare costs for students from some states remain very high, but Rotary and Terri Blakers have come to the aid of students from WA. I am approaching Rotary in SA and Tasmania for similar support.

To make a tax-deductable donation to NMSS please see information at http://nmss.edu.au/donations.

Leon Poladian

Beyond NMSS

Here are updates from two NMSS alumni who work in both maths and education.

Pip Patterson took up the role of Deputy Vice-Chancellor (Education) at the University of Sydney in June 2014, having previously served as Deputy Vice-Chancellor (Academic) at the University of Melbourne.

What a lovely surprise to run into Associate Professor Leon Poladian late last year. Leon was talking about the upcoming NMSS - and I quickly realised this was the very same initiative whose first summer school I had attended in 1969. The memories came flooding back: the wonderful fellow students with whom I attended; and the remarkable lecturers who led us into new and fascinating mathematical worlds.

Apart from the enjoyment of meeting students with similar interests, I found NMSS broadened my understanding of what it means to 'do' maths. I went on to major in pure mathematics and psychology at the University of Melbourme. I then completed a PhD and went on to a career of teaching and research in quantitative and mathematical psychology. My research has involved modelling the structure and dynamics of social networks and processes on social networks, with applications as diverse as the spread of infectious diseases, the dynamics of animal interaction, community resilience and the role of networks within organisations.

We had a truly exceptional group of lecturers at the summer school in 1969 - Larry Blakers, Paul Erdos, Frank Gamblen, Saunders Maclane, Bernhard and Hannah Neumann. Reflecting, I realised just how influential these experiences had been. My early research drew heavily on algebraic concepts either developed or promulgated so elegantly by Saunders Maclane, whereas my more recent work on statistical models for networks had its foundation in the random graph theory initiated by Paul Erdos and colleagues.

Pip Pattison

Michael Milford is a senior lecturer in Electrical Engineering at the Queensland University of Technology by day, and by night he writes and self-publishes books.

I attended NMSS in 1997/1998. I remember the tutors, the maths, but most of all I remember the wonderful people.

I did a BE in Mechanical and Space Engineering, and a PhD in neuroscience-inspired robotic navigation, following my lifelong passion of trying to understand the fundamental nature of intelligence and the workings of the brain, and to try and replicate this intelligence on robots, and I have kept that research track to the current day.

To balance out the exciting but regularly frustrating career that is research, I also run an educational self-publishing business – writing, producing and publishing resources primarily for high school students.

My current project, which I'm really excited about, is an action-packed thriller stealthily packed with key mathematical concepts. The story revolves around Will, a bright but off-track 16-year-old boy, and his efforts to stop a major attack on his Australian city.

The novel is accompanied by tutorials, worksheets and worked solutions, which teachers and students can use to consolidate the mathematical concepts encountered in the book.

If you'd like to read the book, or are interested in the educational side of things, please have a look at www.MathNovel.com – there's a discount on the book available to NMSS readers through http://mathnovel.com/referral/ and schools can access the package at http://mathnovel.com/schools/

Michael Milford

# Mathematics, Origami and Lesson Study in Japan
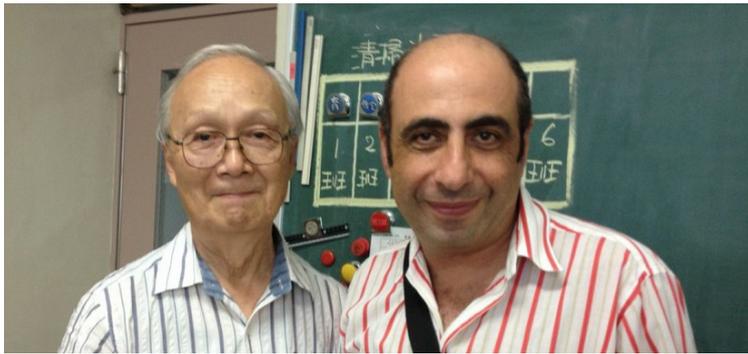
Prof Kazuo Haga with A/Prof Leon Poladian

I attended the 6th International Conference on Origami in Science, Mathematics and Education which was held in Tokyo in August last year. It was one of the most interdisciplinary conferences that I have ever attended with presentations as diverse as how to engineering sturdy bridges from cardboard, to the latest cocktail dress designed by Issey Miyake that flattens neatly into a square to polyhedral nets that fold themselves into boxes when exposed to infrared light. I also spent time with maths teachers from across the world, all interested in using origami in their classes. One highlight for me was meeting Professor Kazuo Haga, a retired biology professor who is the author of "Origamics": a series of popular textbooks on using Origami to teach mathematics.

The second highlight was being invited to participate in a "Lesson Study" at Otsuka Senior High School. Lesson study is a professional development activity common amongst school teachers in Japan and becoming popular in other countries. We are doing something a bit similar by inviting school teachers to NMSS to observe our tutors. I observed a Year 9 mathematics class exploring Haga's theorem: a result he discovered when bored on a bus one day.

Most origami constructions start with folds along lines of symmetry; Haga wondered what would happen if you made an asymmetric fold. He started with the simplest example he could imagine: folding a corner to the midpoint of an opposite edge. He was amazed to see that he had formed several Egyptian or 3-4-5 triangles in the process. Have a go yourself. I will explain the more general version of his theorem below.

Take an origami square of unit size and fold a bottom corner so that it touches the top edge (as in the figure below). At first it seems that you just form a random combination of scalene triangles and trapezoids. Haga's theorem states that if x is a rational number, then so are the lengths and hypotenuses of all the triangles in the diagram (i.e. y and z in the diagram are also rational). In other words, you always form Pythagorean triangles. If x is 1/2 you get 3-4-5 triangles; but if x is 1/3 you get 5-12-13 triangles; and if x is 1/4 you get 7-24-25 triangles. The students were asked to generalise the pattern to when x = p/q. If you label the diagram as below and know some basic geometry (similar
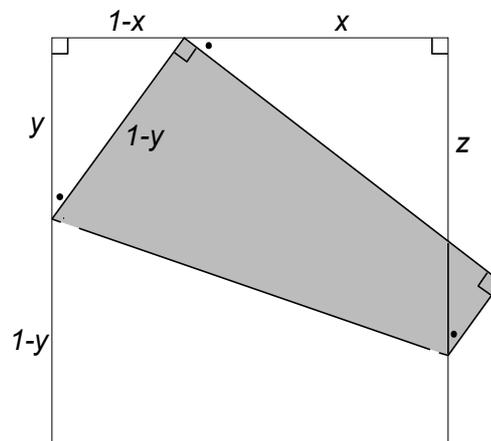
triangles and Pythagoras' theorem) the result is not too hard to discover. During the one hour lesson, many of the Year 9 students eventually found the pattern and a few even proved it correctly!

Leon Poladian

Puzzling Potatoes

You have 2 potatoes and a tube of glitter-glue. You pipe a ring of glitter glue onto the surface of each of the potatoes. Once the glue dries, the potatoes dissolve away and you are left only with two solid, unbendable 3-D rings (made of glitter glue). The question is: given any two potatoes, is it always possible to draw two rings that are indistinguishable from each other (i.e. identical in all three dimensions)?

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interaction with new people every kill, and the students' shared love (or perhaps deadly competitiveness) for mathematical games forged hilarious memories.

I am incredibly grateful for the experiences presented to me at NMSS. Thank you for allowing me to have been a part of this amazing opportunity.

Sarah Li

There's no doubt that the best, BEST part of NMSS was the people that I got to know and become friends with. They came from different parts of the nation, but shared the same passion for Maths.

Before the camp started, I felt scared and worried because I did not know a single other person. It might sound a bit insane, but I was so apprehensive that I literally went onto the NMSS website and downloaded every single post from it, so that I could pre-study the names of all staff members, the map of John XXIII and everything else that I could possibly find.

Looking back, I did not need to do ANY of that, because I was about to meet the smartest, friendliest, loveliest people on earth. I am so glad that I made the decision to come. It was definitely one of the most breathtaking experiences I've ever had in my 16 years of life! For that, I'd like to say thank you to my lovely NMSS cohort.

Rain Chen

Despite initial anxiety, from the moment I was introduced to the game 'Sets' on the way to NMSS, I was convinced that NMSS would be a worthy experience. The open-ended questions posed in Number Theory left us querying our assumptions of mathematics, our brains were stretched to the point of infinity in Projective Geometry, and Ben's gripping topology lectures ignited our eagerness to discover new objects. One's thoughts were permanently submerged within each topic; as depicted by the quiet muttering on the walks back to the dorms and the awkward twisted hand movements as one tried to visualise a klein bottle.

On top of the work studied, the extended games of Mafia and Assassins provided a continuous

To be honest, I didn't know what I was expecting when I first walked through the doors of John XXIII College. I didn't expect to see friendly faces, being greeted with smiles, handshakes and other polite mannerisms. But I was, so I reciprocated. It wasn't hard to make friends, to form social 'cliques', because isn't that what youth do best? Everyone just fit in. It was great, and the maths hadn't even started!

My greatest misconception about NMSS was that all I would do was: eat; sleep; maths; repeat. To say I was wrong was an understatement! Of course, mathematics played a heavy role in NMSS, but so did socialising. Though it was only two weeks, it felt as if I'd been there for a year, as if by leaving I would have to learn how to live again. I befriended many people, made countless memories and learnt a lot of mathematics. A huge thankyou needs to be said to all the staff involved, whether you're the Director, a Lecturer or a Chef, without your commitment, it wouldn't have been the same. It was undoubtedly the best two weeks of my schooling career.

Dan O'Brien