NeMeSiS News 2011

Newsletter of the National Mathematics Summer School

Welkom

Welcome to the 13th edition of NeMeSiS News! We hope that you enjoy reading it.

If you have any feedback on this issue, or ideas or contributions for the next, I would love to hear from you. You can email. Thank you to everyone who contributed.

Merryn Horrocks (editor)

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Terry Reflects on NMSS

I thought I'd write about my time at NMSS. Larry Blakers invited me in 1974. I had met Larry at meetings of the Australian Mathematical Society but I knew him only superficially, since he was in Western Australia and I was in Sydney. I went to NMSS in January with little idea of what to expect. I had taught in a similar program at Illinois University in 1968, but that school was an intensive course of university style lectures and I taught geometry from a textbook. My first course at NMSS was Games like Nim. I think I had a lot to learn in those days.

I was extraordinarily lucky in that that first January was the first time Arnold Ross came. He was a distinguished American number theorist and mathematician with years of experience in such summer schools. I watched what he did and learned from him. He had these marvellous problems.

One such problem asks students to solve a deceptively easy quadratic in integers modulo 15 and then modulo 105. It is still in the problems today. The modulus 105 seems impossibly large for most of them, though some unfortunate people already know how to do it, and so miss the joy of trying other approaches which, although they may not solve it, teach so much mathematics on the way. I've learned over the years about the importance of learning from wrong answers and fruitless approaches. At school, students have been taught that it is the answer which is important. In fact, no one in his or her right mind cares what actual numbers solve that quadratic! It's the excitement of knowing why they solve it that is crucial and it's that excitement I have tried to convey each year.

Until 1984, I taught one of the afternoon courses in parallel with Arnold, trying different courses with mixed success. While Arnold came, I learned. In 1984, when it seemed at the last minute that he could not come, Larry asked me to take the Number Theory. In fact Arnold did come, sitting through all my lectures … since I was teaching his subject from his problems that year it was not easy for either of us! I inserted my own problems in the years after that, but it has been Arnold's problems which have formed the core of the number theory course ever since.

Though I learned academically from Arnold Ross, it was Larry Blakers who was my friend and wise advisor when he was with us. It was lovely to talk in Sydney with his wife Terri just a few days ago. Although the students each year are a continuing source of delight and inspiration, I think that it has been the staff of the school (lecturers, tutors and teachers), which have given me most joy. Such an impressive group of people, I don't know how we managed to find them sometimes. Their commitment has been outstanding and persistent, by and large. Leanne Rylands came to NMSS as a student in 1977 and is still coming! Leon Poladian and Robbie Gates have been coming for a combined total of 53 years! Even this newsletter has been produced by Merryn Horrocks who came to NMSS in 1991 and never really left.

ANU and AAMT Inc have sponsored the school since its inception and NMSS could not have existed without their support, particularly in its formative years.

It is great to hear from past students. Just today I met four of them, including Laurie Fields, a student for two years and a tutor for 4 years a few years ago. He's doing a PhD in Random Walks of some kind at Chicago University (*I have always said that probability and statistics are secret subjects!*) and is back to get married to Kate Turner who was a tutor at the same time and who is also a PhD student at Chicago in mathematics. There have been a goodly number of marriages of people who met at NeMeSiS over the years … wonderful! Laurie's topic reminds me to tell you about *The Drunkard's Walk – How Randomness Rules Our Lives* by Leonard Mlodonov … a serious mathematics book which even talks about the Central Limit Theorem but which contains no formulas! Read it for fun!

It's excellent that my colleague and friend Leon Poladian will take over from me as Director of the 2013 school. I know that under his leadership, NMSS will continue to do what it has done so well these past 43 years, namely to expose and nurture this incredible subject in these wonderful and able young people. I wish it well.

Terry Gagen

Terry Gagen

Leon Poladian

Some News

Terry Gagen is retiring as director of NMSS after NMSS2012. On behalf of everyone involved with NMSS we would like to thank Terry for his contribution to the summer school. There are many people for whom attending NMSS was one of the best experiences of their life, and Terry was central to this. So, "Thank you, Terry". We want to collect and collate memories, comments, messages and photos from as many people as possible to give to Terry. To contribute, send your message or photo to NMSS2012@gmail.com.

Leon Poladian will be taking over as the new director. Although Leon has been attending NMSS for a very long time, he agreed to write a bit about himself for the newsletter. [Ed: *I have memories of playing Robo Rally and building Kinder Surprise toys with Leon at NMSS, but he doesn't seem to have mentioned that here …*]

About Leon Poladian

I first attended NMSS in Jan 1981, when Larry Blakers was director, Arnold Ross taught Number Theory and Terry taught "Rings and Fields". One of the amazing things I remember is that on the last day, Terry showed us how to construct a 17-gon using generators in Z[17].

I returned as an EG in 1982. I remember that John Mack taught Advanced Number Theory (I still remember the proof that all integers are the sum of 4 squares as being awesome) and Mike Newmann did a course on Isometries, where I lost a bet with one of the other students about the total number of different isometries in 3D.

Then I went to Sydney Uni and did chemistry, computer science, maths and physics. In my 3rd year I studied physics and applied maths (but dropped pure maths). Terry said that there were worse choices I could make, like being drowned in salt after having my eyebrows stripped off!

I did honours in physics, followed by a PhD in theoretical physics where I calculated the optical and thermal properties of structures that are made by putting small spheres of metal inside an insulator.

I then worked at ANU for two years in the Optical Sciences Centre, working on chaos and solitons. In 1992 I returned to Sydney and spent the next 14 years at the Optical Fibre Technology Centre on various government fellowships... then finally moved to Sydney University School of Maths in 2004 and eventually got tenure. My research interests are in optimisation theory, evolution and artificial designs.

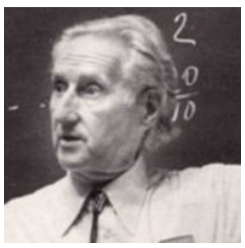
The good things about being in academia are interacting with creative and intelligent people, the freedom to try new things, and being able to choose when and where I work (mostly!).

In 1992 I returned to NMSS to be the EGs' tutor. I also taught chaos theory to the EGs that year. I've been teaching at NMSS pretty much ever since.

Other than maths and physics I like learning new things, especially languages, handicraft skills and IT stuff. I also like science fiction and historical novels, especially those set in quite ancient civilisations.

I will be taking over from Terry as the director of NMSS. The most important thing the director does is choose the staff. I also choose the students but that is done in collaboration with the state maths associations. Also important is mentoring both the staff and the students during the summer school so that everyone does their best and gets given encouragement to develop. More crucial but less exciting is the difficult part of the job where I'll be responsible for making the budget balance and looking for corporate sponsorship.

Leon Poladian



Arnold Ross

Larry Blakers

Gauss and the Orbit of Ceres

Carl Friedrich Gauss (1777--1855) is regarded as one of the most important scientists and mathematicians ever to have lived. But the work that made Gauss famous in his own time had nothing to do with number theory; rather it was the calculation of the orbit of the dwarf planet *Ceres*.

A dwarf planet is an object that has enough mass so that its self-gravity squishes it into a roughly spherical shape, but not quite enough mass to clear its neighbourhood of other debris. Ceres' radius is about 490km, roughly half that of Pluto, and it orbits the Sun at an average distance of 414 million kilometres, in the main asteroid belt, about halfway between Mars and Jupiter. It accounts for about a third of the estimated total mass of asteroids in the Solar System.

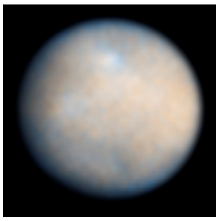
Ceres was discovered by Giuseppe Piazzi in 1801. He observed it 24 times, but it was soon lost in the glare of the Sun. The challenge for astronomers of the day was to calculate its orbit based on these meagre observations, and hence locate it again when it reappeared from behind the Sun.

This was regarded as an exceptionally difficult problem in the early 19th century. The famous mathematician Laplace believed that it could not be done. The only known methods of calculation assumed that the orbit was either a perfect circle (in the case of a planet) or a parabola (for a comet). This was despite the fact that it was already well-known that the trajectory could lie on any conic section with the Sun at one focus, including an ellipse.

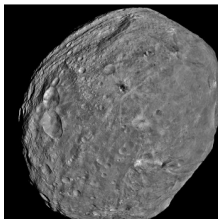
Gauss took a thoroughly modern approach to the problem. He assumed only that the orbit was an ellipse. There are six unknowns: the angle between the plane of Ceres' orbit and that of the Earth; an angle describing the position of the line of intersection of those two planes; an angle describing the orientation of the ellipse within this plane; the maximum and minimum diameters of the orbit; and the position of Ceres at a given point in time. On the other hand, each of Piazzi's observations yielded two quantities: the latitude and longitude in the sky of Ceres at a known point in time.

Gauss therefore started with three of Piazzi's observations, and solved the resulting (very complicated) system of equations for the six unknowns. He had to correct for, among other things, the changing position and rotation of the Earth. This gave a first approximation to the orbit. Then he applied the method of least squares - which he had invented as a teenager - to refine his estimate to find the best fit to the rest of Piazzi's data.

Several months later, when astronomers pointed their telescopes skyward again, they found Ceres < 0.5º



ceres



vesta

from where Gauss had predicted. The predictions of other eminent astronomers did not fare so well.

In September 2007, NASA launched the *Dawn* spacecraft, whose mission is to visit Vesta (a large asteroid) and Ceres. It reached Vesta in July 2011 and took some fabulous photos. It is scheduled to depart Vesta in July 2012, and arrive at Ceres in February 2015. Dawn is the first spacecraft to orbit an object in the main asteroid belt, and if all goes according to plan, it will be the first craft to enter orbit around more than one Solar System object.

One clear evening last week, I looked up the position of Vesta on my laptop with the help of the free software package *Stellarium*. I went outside with my binoculars, a tripod, and a star chart, and was able to find Vesta in a few minutes. It was amusing to imagine Dawn orbiting that tiny dot, and to think how easy it had been for me to pick it out from all the millions of other tiny dots in the sky, and to consider how the best minds in the world struggled with that problem just two hundred years ago.

David Harvey

CAN YOU HELP?

As you are aware, the NMSS needs all the support that you can give. The school only remains viable because of the donations of past students and their parents. I urge you to make a tax deductible donation if at all possible.

Electronic Funds Transfer:
BSB: 082 902 (NAB)
Account: 674507553
Name: ANU General Account
Please put NMSS in the reference

Cheques should be made out to Australian National University (NMSS) and sent to T M Gagen, Director NMSS, School of Mathematics and Statistics, University of Sydney, NSW 2006.

Thank you for your continued support of NMSS.

Update from Megan Casey

I went to NeMeSiS back in the Bruce Hall days in around 1989 or 1990 - seems like a lifetime ago, but it was a fabulous opportunity to spend time around really bright people who got enthused about similar things. I then went on and did a double degree in Science Law at Monash University in Melbourne, Victoria. One Honours Degree in Applied Maths later and I couldn't figure out what to do a PhD in. (I still regret not choosing Chaos theory for my Hons project!)

So, I finished my law degree, applied for articles, spent 5 years as a miserable commercial lawyer in a big firm and then ran away to Ireland to never be a lawyer ever again, not even if you paid me.

That didn't quite work out as planned - I ended up working there in criminal defence, loved it and am now happily self-employed back here as a barrister, practising predominantly in crime. I think I wouldn't even understand my Honours Thesis these days but the discipline of maths proofs is what (I hope) makes me a good lawyer. Crime is the perfect mix of people and problem solving and you apply the law to determine what the outcome ought to be. So it's just like maths but with words rather than letters and numbers!

NMSS2011

When Terry invited me to return to NMSS in 2011, I jumped at the opportunity. The last time I was at NMSS, it was 2007 and I was an EG. Of course I would love to come back, I said. What's there not to love about NMSS? It would be two whole weeks with amazingly cool people from all over Australia and the chance to do some seriously awesome maths. And this time, I'll be on the opposite side of the desk; I'll be the tutor, not the student.

So having experienced NMSS in all three of its glorious stages, as a first time student, a returning EG and now, also as a tutor, let me share with you three new things I've discovered this year:

1. Just how much sense a number theory lecture makes is proportional to how many times you attend that same lecture. Let's just say the number of new things I've learnt about number theory this time round as a tutor will not fit into any modulo.

2. The games and jokes I learned as a student are still being passed on. I was initially skeptic having not attended a single NMSS in four years, but it was like I never left. The only difference is now we're bouncing each other's iPhones around the dinner table rather than ordinary cutlery. It was like coming home.

3. So being an oblivious student back in my days, I never knew and always wondered what the tutors did in their spare time. Let me now tell you, we do more maths. Voluntarily. And love every minute of it. I was terrified when I first learnt on arrival at NMSS this year, not having ever done Topology at a previous NMSS Camp nor during University, that I was expected to tutor it. It was made even more daunting when Ty, a fellow tutor warned me, "Make sure you know the punch line, it is crucial to the course. But don't worry, if you don't know, you'll find out in Ben's last lecture." Thanks to the help of some of the amazing tutors (you know who you are), I did not have to wait until that last lecture. Although, I must say, it is a punch line worth waiting for.

NMSS is an amazing experience and this is true regardless of how many times one attends. I've had a number of people ask me when I came back home "how did this year compare?" and I must say "it was the best". Cheers NMSS 2011.

Note: For those of you who are curious now, the punch line I'm talking about is the Classification Theorem of Closed Surfaces.

Stephanie Wang