National Maths Summer School

By Lachlan Anderson

This year, from the 6th to the 19th of January, I had the opportunity to attend the National Maths Summer School, at ANU in Canberra alongside Nafi Mazid, who was selected to return as an experienced student. The aim of the NMSS is to provide students with the tools to "think deeply about simple things" and to teach mathematics in an uncompetitive and open-ended learning environment.

Not surprisingly, the schedule at NMSS was somewhat maths dominated, with each day beginning with an hour lecture, followed by a two-hour tutorial. A quick lunch break then ensued, allowing vital nutrients lost during the intense math to be recovered, before it was back into the one-hour afternoon lecture, one-hour tutorial and one and a half-hour individual study session.

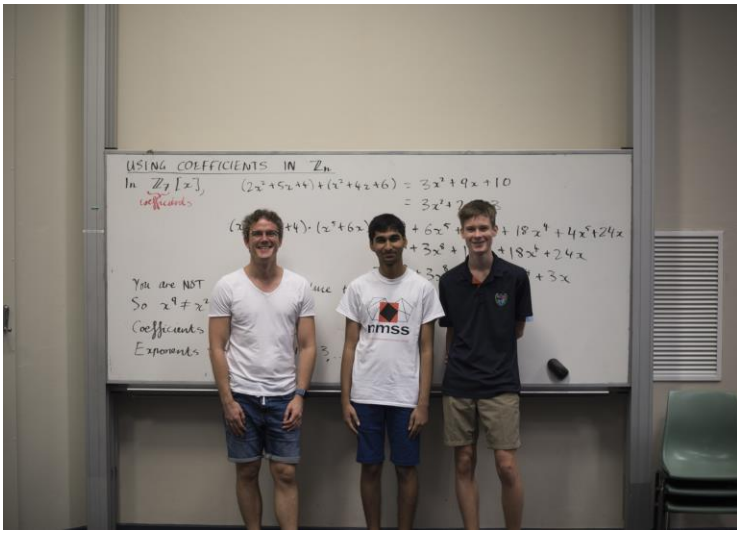
The primary subject studied at NMSS was Number Theory, which was taught by Norman Do and David Harvey. The two-week Number Theory course spanned over a range of topics, including multiplication, addition and inverses in modular arithmetic, fundamental axioms, polynomial rings and ring isomorphism, gaussian primes and using Euclid's Algorithm to find greatest common divisors and to solve Diophantine equations.

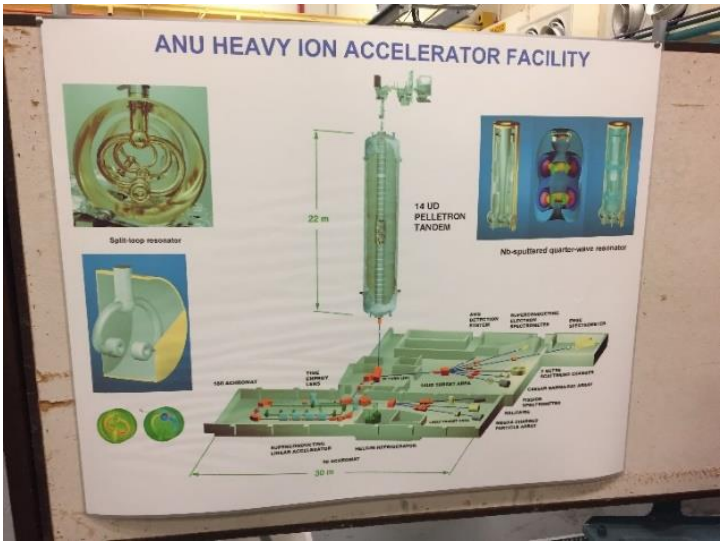
Knot Theory was also taught at NMSS, by Summer School director Ben Burton. Knot Theory is concerned with determining whether various knots are equivalent to each other, or to the unknot (an empty loop) using 'invariants'. To achieve this noble goal, we used processes such as manipulating knots using the 3 Reidemeister moves, calculating the writhe and 'bracket polynomial' of knots and using crayons to find a knot's 'n-colourability'; by far the least efficient, but most enjoyable method. The course also briefly touched on 'tangles' and torus knots.

The final topic we studied was Projective Geometry, the subject area of lecturer Leanne Rylands. Projective geometry centres on predicting how certain shapes will appear when projected onto various planes and with studying the 'real projective plane' and associated concepts such as points at infinity.

The NMSS also provided us with a range of other activities to prevent us from losing the will to go on after our daily 6 and a half hours of maths, such as the ‘maths relay’ and alumni lectures in which past attendees explained how they had transitioned into careers in a range of areas. Additionally, we were invited to visit the ANU Heavy Ion Accelerator, which uses more than 15 million volts of electricity to conduct exacting mass spectrometry (assess the chemical composition of materials) and to study the strong nuclear force. And, of course, there were visits to Parliament House, Questacon and the Telstra Tower, without which no visit to Canberra would be complete.

Overall, it was a great chance to learn from experts in their fields and to meet people who share my interest in maths and science and who also have limited social skills. I would like to thank the Mathematics Teachers Association of the Northern Territory for and, of course, the Legendary Mrs Tan for nominating me.





Questions

Number Theory

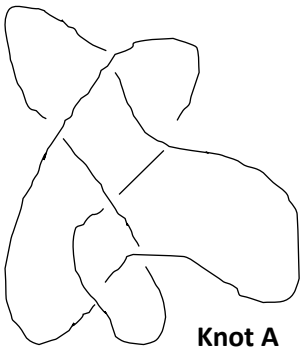
Find at least one solution for x and y in each of the following.

1. $13y + 8x = 1$
2. $13y + 8x = 11$
3. $47x + 17y = 0$

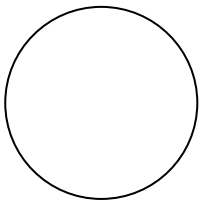
Now find all solutions.

Knot Theory

Make knot A, into the unknot. You can twist, bend pull and stretch each strand, but not cut them.



Knot A



Unknot

Projective Geometry

A light (point source) is at point (1,1). The line segment from $\left(-\frac{1}{2},\frac{1}{2}\right)$ to $\left(0,-\frac{2}{3}\right)$ casts a shadow on the line $x=-1$. Find exactly where the shadow is.