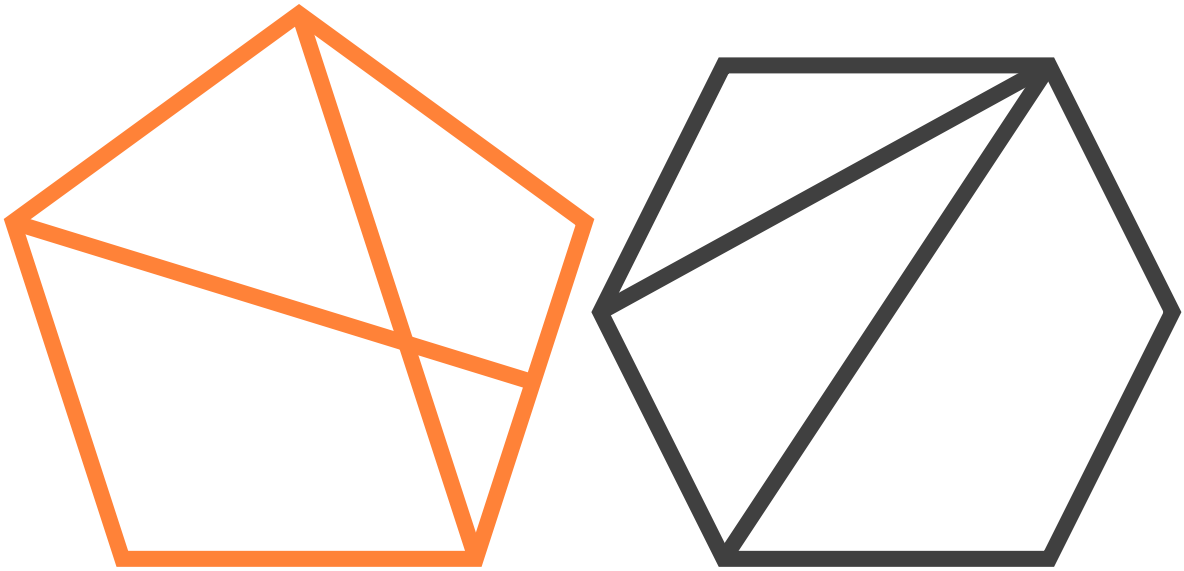


NEMESIS NEWS

ANU-AAMT NATIONAL MATHEMATICS SUMMER SCHOOL 2022

In January of this year, another National Mathematics Summer School (NMSS) flew by and drew to a close, with 84 students going through the program.

This year's NMSS newsletter recaps some of the successes and difficulties in running yet another completely virtual summer school (all the while with our fingers crossed that it will be our last) with a report on the school written by two of our tutors this year, Jodie Lee and Dana Ma; two student reflections; and, as always, a word from our phenomenal director, A/Prof Norman Do.

The newsletter also takes a glance at the world of mathematical careers. In *It's a good time to study mathematics*, Dr Adrian W. Dudek tells us that it's not just the mathematics we learn but also the skills we cultivate that are highly prized by employers today. Further, in *Mathematical Careers*, editor Ellena Moskovsky gives a bit of hands-on advice about the practicalities of finding a career after having studied mathematics.

And finally, we also feature a NMSS-themed cryptic crossword that was composed specifically for the summer school this year!

Ellena Moskovsky
Isabel Longbottom
Editors 2022

ANOTHER EXTRAORDINARY SUMMER SCHOOL

By Jodie Lee & Dana Ma
NMSS Tutors 2022

Even though lockdowns, outbreaks and border restrictions prevented us from having an in-person summer school, students and staff gathered online from all corners of Australia to attend the virtual 2022 National Maths Summer School. Although online, the school followed a typical NMSS format with a busy 10-day schedule packed with lectures, tutorials, social events and more! Additionally, this being the second year online came with perks – the staff were (supposedly) more zoom savvy and students were more accustomed to the extended screen time and online learning.

> *“… students and staff gathered online from all corners of Australia to attend the virtual 2022 National Maths Summer School*

Communicating online certainly presented some challenges, for example, it’s much more difficult to force students to go to bed at curfew. Also, we are yet to find a seamless equivalent to looming over students’ shoulders to peer at their work! However, we didn’t allow these technical limitations to derail the learning experience and everyone’s enthusiasm for mathematics came across loud and clear.

Lecture content delivered over modern communication was supplemented with more classical means of studying mathematics, with students painstakingly drawing out magic tables with pen and paper, and diligently making use of the cameras-off private study time to think deeply about simple things in their own space. Both staff and students enjoyed numerous engaging and thought-provoking 1:1 sessions where excellent questions were met with cryptic answers in the time-honoured NMSS tradition, and students also found breakout rooms to be a valuable way to share ideas and solve problems together.

> *“… we didn’t allow these technical limitations to derail the learning experience and everyone’s enthusiasm for mathematics came across loud and clear*

Our academic program was accompanied by the Alumni lectures, given by the incredible Sarah Barker and Dr Robbie Gates, and the Blakers Lecture by Prof. Rob Hyndman. These talks were a personal highlight, discussing a diverse range of topics with everything from modelling COVID data to leveraging data science in industry and the non-for-profit sector which truly opened our eyes to the breadth of places a strong mathematics foundation can take you.

Once again, Discord housed many chances for students to hang out, whether it was by starting the day with Wordle (plus a fresh NMSS twist!), or by showcasing creativity, competitive spirit and fast Internet connections in hotly contested competitions of Draw Battle, or by unwinding after an intense day of

mathematics with a relaxed game of Fishbowl or Set. Our ‘common room’ was a great space to hang out, chat about everything maths and non-maths related and make some lifelong friends.

> *“ Our ‘common room’ was a great space to hang out, chat about everything maths and non-maths related and make some lifelong friends*

The Experienced Group students (EGs) did a truly remarkable job of keeping the NMSS spirit alive with the vibrant social scene. From enticing the main group of students to Discord through ad hoc games, an informal Q and A, and a brilliantly constructed online puzzle hunt, to organising numerous evening Zoom games and events, the EGs were tireless in their efforts to ensure everyone could have an authentic NMSS experience.

And at the end of the day, despite the challenges of an online NMSS for the second year running, the students really were able to experience a genuine mathematical adventure and a truly unforgettable NMSS. This is in huge part due to the tremendous generosity and hard work of the senior staff and the EGs, for which we are profoundly grateful.

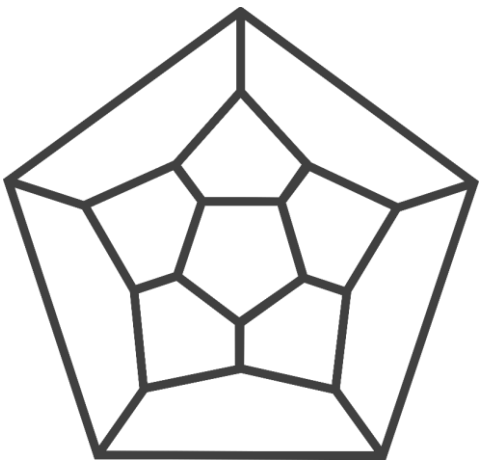
SPIDERS AND BEETLES

Three spiders try to catch a beetle in a game. They are all initially positioned on the edges of a regular dodecahedron whose edges have length 1. At some point in time, they start moving continuously along the edges of the dodecahedron. The beetle and one of the spiders move with maximum speed 1, while the remaining two spiders move with maximum speed 1/2022. Each player always knows their own position and the position of every other player. A player can turn around at any moment and can react to the behaviour of other players instantaneously. The spiders can communicate to decide on a strategy before and during the game. If any spider occupies the same position as the beetle at some time, then the spiders win the game.

Prove that the spiders can win the game, regardless of the initial positions of all players and regardless of how the beetle moves.

A regular dodecahedron *is a convex polyhedron with twelve faces, each of which is a pentagon with equal side lengths and equal angles. Three faces meet at each vertex.*

Hint: You can visualize this game in 2D by looking at the projection of a dodecahedron onto the plane – see below.



This problem was sourced from the 2018 Simon Marais Mathematics competition: simonmarais.org.

IT'S A GOOD TIME TO STUDY MATHEMATICS

By Dr Adrian W. Dudek

It's a good time to be nifty with numbers. Actually, scratch that; it has always been a good time for a budding maths nerd. If you continue upon your current delightful mathematical path you will find yourself with more careers available to you than the average graduate. To name a few:

- Academic
- Data scientist
- Machine learning engineer
- Stock/options trader
- Maths teacher
- Analyst
- Biostatistician / bioinformatician
- Software engineer
- Actuary
- Consultant

The truth is, the *hot* list of jobs might very well be different by the time you are ready to start paying your own bills!

> *Maths empowers you wherever you go*

You will also find that the above list will not capture everyone. There are mathematicians that go on to make video games and others that go on to have political careers. Maths empowers you wherever you go.

But let's think about *why* that is the case. Specifically, *why* are maths geeks so prized when it comes to jobs?

The first answer to this is that mathsy folk have the technical skills needed to make sense out of the tsunami of data and information out there. The main weapons they wield are those of **statistics** and **programming**, but these are often the hammers in their mathematical toolkit.

The **maths** itself (and I mean the good stuff like calculus, linear algebra, probability, etc.) serves to break open a data set so that we can look beneath. By having a strong knowledge of the fundamentals, we can try to build models to explain how the data is being generated in the first place. This can result in brand new insights!

> *… maths serves to break open the data set so that we can look beneath*

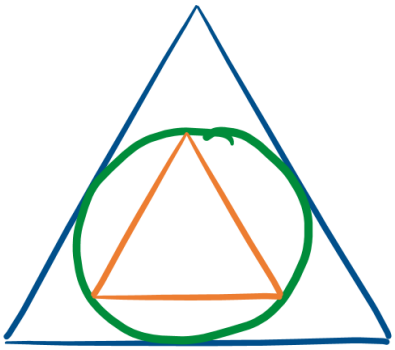
Does that make sense? Anyone with the internet can look up a few programming packages, download some data and calculate some statistics. They can even generate a few graphs. However, without maths they will not be able to properly model and understand the underlying processes. And what's more – they need maths to understand the downfall of certain statistics for different scenarios.

In short, the way I think about it is like this: we have tools for *doing*, like statistics and programming, and we have tools for *understanding*, like calculus and other mathematics. So a well-trained maths nerd has the ability to understand and solve complex problems. Could an employer really want anything else on the problem-solving front?

Well, yes, they could. As we all know, some solutions are better than others.

> *Could an employer really want anything else on the problem-solving front?*

Let's say that you're bored (or excited!) and you inscribe an equilateral triangle inside a circle that is itself inscribed in an equilateral triangle. Here's a picture from somebody who definitely does not deserve their pen licence (I'll get it one day):



Problem: If the area inside the smaller triangle is 1 unit^2, what is the area of the outside triangle?

Now, there are many ways to solve this. The first approach that a lot of students take is to bust out the trigonometry and *do the maths*. But there is a much quicker way where you can spare the pen and paper altogether. Being NMSS students, I'm sure this won't take you long.

The second way is to rotate the inside triangle 180° to see that its edges neatly break the larger triangle into four equal triangles. Therefore, the outside triangle has an area of 4 units^2.

A student who attempts things using trigonometry is engaging in *linear thinking*. To be clear, this is an absolutely fine way to get things done! However, the short, sharp, second approach is an example of *lateral thinking* or, to use a well known phrase, *thinking outside the box*!

In general, mathematicians are incredible lateral thinkers. They find simple, creative and unique ways of solving problems. This can save time and lead to new approaches for solving entire classes of problems.

So, it is lateral thinking, when paired with the technical skill set, that makes students of maths incredibly valuable for employers. To maximise your chances of having a successful mathematical career, I have some tips. First of all, follow your heart and do the maths that you love! For example, if group theory is your thing, go and learn as much as you can. If, on the other hand, you think prime numbers are a little bit cute, then it's number theory for you.

Some of you will follow your beloved areas into an academic job and never look back. Others might look for jobs in industry working at companies like Optiver or Google. Wherever you might end up, you can increase your chances for success massively if you:

- Learn some statistics at the university level. A first course in regression and hypothesis testing is enough for a lot of jobs out there.
- Learn at least one programming language to a reasonable level. Again, you can do this at uni or use some of the infinitely many resources available online.
- Become a strong communicator of maths. Learn how to talk to others (especially non-mathematicians!) about maths. Having clear communication skills is important. You could start a blog (like MathsFeed.blog) or participate in a group reading course. Looking for tutoring opportunities will help a lot as well. Ultimately, you will need to be able to explain all of your hard mathematical work to the person who pays you.
- Be dynamic. Don't try and plan too far ahead! If you're a budding academic, it can be hard to forecast what country you will be in ten years from now. Stay nimble and focus on the one constant: your passion for maths.

To wrap things up (there are problems out there that need solving!), it is quite simple to make sure that you are geared for a bright mathematical future. The fact that you're reading a NMSS Newsletter indicates that you're on the right path. Continue down this path, follow my tips (along with the advice of others) and you will find yourself getting paid to do the maths you love.

INTERVIEW WITH PROF CATHERINE GREENHILL

Interviewed by Dr Melissa Lee
NMSS 2022 tutor

Tell us a bit about yourself.

I'm a mathematician and Professor at UNSW Sydney. I grew up in Brisbane and did my undergraduate degree at the University of Queensland, then lived in the UK for a few years, first as a doctoral student in Oxford and then as a postdoctoral researcher in Leeds. I came back to Australia to do some more research at the University of Melbourne, before joining UNSW Sydney as a lecturer at the start of 2003. I've been here ever since. I'm also the mother of two teenagers (we keep feeding them and they keep growing).

What are your research interests?

I work in an area called combinatorics. This includes the study of networks, which we usually call graphs. A graph consists of some objects (vertices) with some pairs of objects being joined by edges, usually drawn as a line between two vertices. But you could also define a random graph, for example by flipping a coin for each pair of vertices to decide whether or not they are joined by an edge. Random graphs are useful in many areas, including computer science and physics, for modelling large discrete systems. I work with families of graphs with certain properties, and try to answer questions like "How many graphs are there in this family?", or "What does a random graph from this family look like?", or "How can I (algorithmically) produce a random graph from this family?". These sort of questions are relatively easy to explain, but can be very challenging to answer.

Prof Catherine Greenhill (Photo: Talya Jacobson)

What does a day in the life of a mathematician look like?

Usually my day involves a lot of different things. I might have a supervision meeting with a student, a research meeting with my postdoc, or some kind of committee meeting. I might be preparing for teaching, or actually teaching: all my teaching is still online this term. There are always emails waiting for my reply! I'm an editor of a journal, which means assigning submissions to referees, sending reminders to referees and letting authors know whether their paper was accepted. Sometimes I need to prepare a talk to deliver to a conference or seminar series. It can get very busy but I also find it very rewarding, especially when I can help a student understand a concept for the first time.

Have you always wanted to be a mathematician? Tell us about how you came to be where you are now.

When I went to university I knew I wanted to do a Bachelor of Science but I didn't have a clear idea of exactly what I wanted to study. By my third year I had narrowed my focus to maths and computer science, then I decided to do Honours in pure mathematics. I really enjoyed it and wanted to keep going, so I did a research Masters after my Honours year, and then was lucky enough to get a place (and a scholarship!) to go to Oxford for my doctorate. By the end of my doctorate I was a fully-fledged mathematician, and my first job was as a postdoctoral researcher in a computer science department. (My research lies at the boundary of combinatorics and computer science, and these boundaries are very porous.) Overall, I didn't really have a clear plan, but I followed my interests and worked hard. I was given encouragement by my lecturers and supervisors, and I had some luck along the way.

"My research lies at the boundary of combinatorics and computer science, and these boundaries are very porous.

You're currently the chair of the Women in Mathematics Special Interest Group (WIMSIG) of the Australian Mathematics Society. What does the group do?

WIMSIG was formed in 2013 to support and encourage women in the mathematical sciences in Australasia. WIMSIG does lots of things! We offer travel grants and support for mathematicians with carers' responsibilities, we produce a monthly newsletter, we run a mentoring scheme, and we organise regular networking events. Our two biggest events so far have been the WIMSIG Conferences, held in 2017 (in person, in Adelaide) and in 2021 (a mixture of in person and online, through local "hubs" in major cities). The 2017 conference was the first mathematics conference in Australia where all research talks were given by women, and it was an amazing experience. Last year WIMSIG expanded our aims to encompass all underrepresented genders, as we advocate for gender equality and inclusion in the mathematical sciences.

What has been the proudest moment of your career?

Recently I was elected as a Fellow of the Australian Academy of Science, which is a tremendous honour. I was also very proud to be a plenary (invited) speaker at the British Combinatorics Conference 2021, which was held online but organised by colleagues at Durham University. This is one of the two biggest combinatorics conferences in the world.

What's something cool that you've been able to do as part of your job?

One of the best parts of doing academic research is being a member of a community which is spread around the globe. No-one has done much travelling lately, but I have definitely enjoyed the travel that I have been able to do as part of my job. When researchers get together, we learn about each other's recent work, talk to each other about ideas for new projects, and laugh at each other's extremely niche maths jokes.

What's some advice you would give to your younger self?

I guess I would say, follow your interests. If you're interested in what you're studying or working on, then you will put more into it and get more out of it. I also like the advice that my doctoral supervisor, Peter Neumann gave me once. He said "Catherine, you are letting the mathematics bully you. You need to start bullying the mathematics!". He meant that I needed to push harder, try things a different way, and not just give up when something seems difficult. I still repeat this advice to myself today.

STUDENT REFLECTIONS

Maya Schildkraut
NMSS 2022 Student

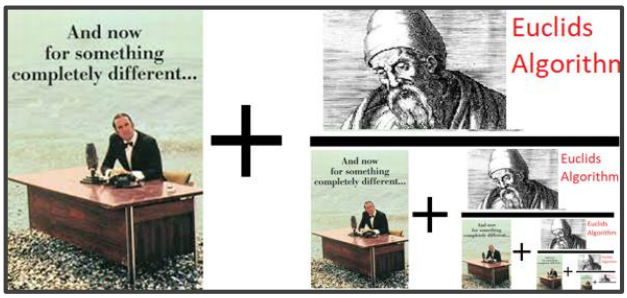
My parents teased me relentlessly when I told them I was signing up for a maths camp over the school holidays. A week, online, voluntarily doing extra maths, for fun? Yes, I know it's not for everyone, but the moment my teacher told me about NMSS, I knew I had to apply. To me, mathematics has always been something elegant and beautiful, and a way to connect with other people, and experiencing NMSS only deepened my love for it.

There's something so special about meeting 80 other people your age from all around the country who love maths just as much as you do. Throughout the camp, we got to know each other better by playing (and winning) a Draw Battle tournament, helping each other with cryptic crossword clues, sharing Wordle results and trying to get Norm to say "candle". We spent our nights in the EG-run sessions of Letters and Numbers, Family Feud and Only Connect, as well as losing to Sean in Word Bench.

Of course, it's a maths camp, so we did actually do some maths, not just play games. In Merryn's Algorithms lectures, I learnt so much about zombies, Turing machines and sorting algorithms. I think we all came away from the camp with a deeper understanding of how algorithms work and what they can be used for. On the other hand, Norm only really taught one thing – Euclid's algorithm.

In reality, that one concept led to interesting discussions about magic tables, continued fractions, Diophantine equations and many more topics that are never mentioned in school (credit goes to Nicholas Chatterton for the meme below).

I'd like to thank all the tutors, other staff and EGs for making this camp so special. It was truly the highlight of my holidays. I made so many friends from it that I talk to over discord and in person, I feel like I have a greater understanding of so many mathematical topics, and of course, I get to drive my friends crazy by telling them "you should think about it" whenever the opportunity arises.



Created by Nicholas Chatterton, NMSS 2022

Ars Mathematica

Enda Han
NMSS 2022 Student

I was struggling to start this piece so I thought I might browse through some of my past writing in the hopes of finding some inspiration. While browsing, I happened across a piece I wrote earlier this year in my school's student-led magazine – it started a little like this:

According to Wikipedia:

'The word mathematics comes from Ancient Greek máthēma meaning that which is learnt*'.*

And indeed, this crude multi-millennia-old definition might vaguely resemble your impression of mathematics' purpose – a pursuit of the attainment of knowledge.

I would, however, argue that perhaps this evaluation of what mathematics is, is not entirely accurate. Sure, there are the superficial dissimilarities, most glaringly that it makes no mention of numbers, operations,

or anything remotely similar, but the dissimilarity I refer to is something far more fundamental.

A few hundred years later, in the post-Augustan age of the Roman empire, the phrase 'ars mathematica' emerged in literature referencing mathematics – literally the mathematical art. The astute among you might discern a slight difference in these renderings, in that within the post-Augustan interpretation, art is now affixed, suggesting an inherent creativity and elegance in the study of mathematics.

I, like many of you, have never really been a stranger to mathematics. Perhaps what originally attracted me to it was simply that there was no ambiguity, it was black and white, it made sense, it was easy – how wrong I was.

> *Perhaps what originally attracted me to [maths] was simply that there was no ambiguity, it was black and white, it made sense, it was easy – how wrong I was.*

Never would I have thought I would spend 8 days in January trying to find the least residue of 411^{411} mod 757 – and not figure it out; never would I have thought I would spend 8 days calculating remainders – and not get bored; never would I have thought … oops, maybe I should stop spoiling the program! I have participated in my fair share of extension maths programs, but I must say that there is nothing like NMSS, nothing fosters thought, experimentation, and extreme exhaustion quite like NMSS.

I learnt that to say maths was black and white was to say that I was colourblind. Indeed, just below the surface of the most elementary mathematics was a world of colour just waiting to be discovered. NMSS, excuse the romanticism, showed me that colour and elucidated for me that phrase the Romans thought up millennia ago. It taught me the beauty of struggle and exploration and together with the people I met, our collective cringing at Norm's jokes, the games I learnt and played with my newfound friends, and the hours I spent losing my mind over Input/Output, the 9 days I spent as an IG at NMSS will forever be ingrained into my memory, perhaps a moment of sobriety (or inebriation, I can't quite figure that out) in the lockdown-studded purgatory that has been the past two years.

> *Indeed, just below the surface of the most elementary mathematics was a world of colour just waiting to be discovered*

Perhaps you might expect to learn maths at a mathematics summer school, but I walked – or, more accurately, Zoomed – into NMSS 2022 thinking I knew a reasonable amount, and rather than feeling more educated, I came out questioning everything, uncertain of everything and with nothing but my curiosity and passion intact. And what's more, I don't regret it one bit, after all, are these not the only tools one could possibly need? Sure, I learnt some maths, but, surprisingly, I don't think that was the point.

I closed that same article with the following:

Whenever you think that mathematics is dull, tiresome, or boring, I encourage you to lend some credence to the Romans and to think deeply about simple things.

Maybe you might like to hazard a guess as to how that was coined.

To many, just the thought of doing mathematics for 6-7 hours a day for more or less a week straight might trigger a gag reflex, and perhaps that's the reasonable response. But for our collection of almost masochistic individuals for whom said reflex wasn't triggered, NMSS 2022 provided a week which, looking back on it, could only be described as nigh on bliss.

Thanks for the experience of a lifetime.

A LIGHTBULB MOMENT

By Dr Adrian W. Dudek

This article has been sourced from MathsFeed, an online blog for maths students.
https://mathsfeed.blog/

Here is a tale almost everybody can relate to.

The attic smells absolutely awful. Your mum has sent you up here to bring your weird uncle (everybody has one of these, right?) down for dinner. These day, he just sits in the attic playing with lightbulbs. It's an odd obsession and, quite frankly, the family is starting to worry.

His eyes widen when he sees you walk through the door and he beckons for you to come over and sit with him. You carefully tread your way towards him, being particularly careful to avoid the mousetraps he enjoys laying down on the floor.

You try to tell your uncle that it's dinner time, but he doesn't seem to hear you.

"I don't understand" your uncle whispers, staring at a row of 100 lightbulbs that he has in front of him. Each of these is plugged into an electrical socket, and some have been switched on. It's all a bit of a mess.

Your uncle's eyebrows are sharply flexed. His brain is pulsating noticeably within his head; he is sweating heavily and breathing almost uncontrollably. It's quite obvious what is going on here. Your uncle is working on a maths problem.

You think for a brief moment. Perhaps, if you could help your uncle solve the problem that has been perplexing him, then he might come down for dinner and you could have the apple pie and custard that you've been thinking about since you woke up. It's worth a shot.

"What's the problem" you ask your uncle. He turns to look at you and a wicked smile breaks across his face.

"I have a row of 100 lightbulbs" he says excitedly, as if he were announcing a Nobel prize winning project. He points at the row of bulbs in front of him. "Let's turn them all off to start with." He fumbles around for the switches, and soon manages to turn every light off.

"Now, my young-relative-who-never-visits-me-unless-there's-pie-in-the-oven, watch carefully."

Slowly, working from left to right, he turns on every switch. The lightbulbs are now all on.

Then, he goes back to the left, and this time he presses every second switch. This turns off half of the lightbulbs. He has shut off the lightbulbs in the second position, the fourth position, the sixth position, and so on.

Returning to the left of the row again, this time he presses every third switch. And now it gets a bit crazy. Some lights are turned off and some lights are turned back on. For example, the switch in the third position is now off, but the switch in the sixth position is now on.

Let's summarise what has happened so far. In his first sweep across the lightbulbs, your uncle pressed every switch, turning them all on. In his second sweep across, he pressed every second switch, turning every second bulb off. In his third sweep across, he pressed every third switch; this turned some on and some off.

"If I keep doing this" your uncle wonders aloud, "then after my one hundredth sweep across the lightbulbs, how many of the lightbulbs will be on?"

You are stunned, not just by the complexity of the problem he has asked you, but by the fact that your uncle actually spends his spare time thinking about such problems. But you're not afraid. You know that with the help of this blog post author and a little persistence, you can solve this problem.

Before I even tell you how to help your mathematically troubled uncle, why don't you just try to answer the problem yourself?

Exercise: How many lightbulbs will be on after 100 sweeps?

I like this problem because it gives me a chance to watch people struggle before I give them a piece of advice (not even a hint!) that helps them to solve it.

Advice: Shrink your problem down.

When presented with a tricky problem, *scale* it down so that it becomes an easier problem that you can play with.

Think about the 100 lightbulb problem for a second. You could draw 100 lightbulbs on a piece of paper. Then you could put a line through each of them to indicate the first step where each switch gets flicked and they all get turned on. Then you could put a second line through every second one of them to indicate the step where every second one gets flicked. And so on.

But why would you spend so much time doing this when you could just make the problem easier?

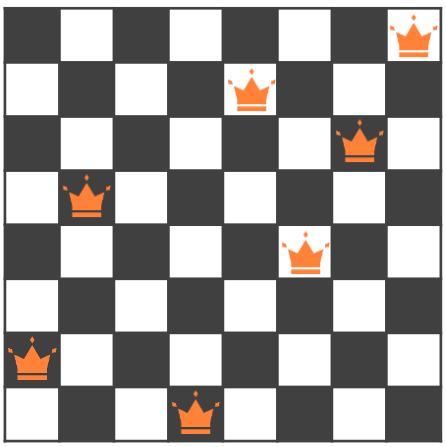
Subexercise: Consider the same problem but with 10 lightbulbs. How many lightbulbs will be on after 10 sweeps?

Now, this is very quick to do. So do it! And then, when you're done, see if this naturally leads you to solve the problem yourself.

Visit mathsfeed.blog/a-lightbulb-moment/ for the solution!

8 QUEENS

Place 8 queens on a chessboard so that no two queens are attacking one another – that is, no two of them lie in the same row, column, or diagonal. Below is a non-solution: 7 queens have been placed such that there is no square in which an eighth queen may be added.



After attempting this problem for some time, one may arrive at a solution. A non-mathematician will likely celebrate this success and move on to other things. A mathematician, on the other hand, may be motivated to investigate the problem more closely.

There are some immediate questions which spring to mind as worthy of further study: Are there any other solutions? How many? What about placing n queens on an $n \times n$ grid – does a solution always exist? Can a solution with symmetry (rotational or reflectional) be found? What if the chessboard is inscribed on the surface of a donut? The most adventurous among you may even be motivated to consider higher dimensions – for example, how many queens can be placed on a $3 \times 3 \times 3$ 'chessboard' without attacking each other?

MATHEMATICS CAREERS

By Ellena Moskovsky
NMSS 2022 Tutor

If you are, or were at one point, a mathematics student at university, then you're probably familiar with the question "Oh, what will you do with maths once you've finished studying?" Or "So will you become a maths teacher?"

With 3 years of undergraduate study followed by an Honours year and 3.5 years of a PhD, all in pure mathematics, I can assure you I'm personally very familiar with this question.

If this all sounds very familiar to you, you may have been surprised by the earlier article *It's a good time to study mathematics* by Dr Adrian Dudek, where Dr Dudek claims that mathematicians are in fact in very hot demand in the workplace. One just needs to take a look at the best jobs of 2021 to confirm this.

Top jobs of 2021

As per *careercast.com/jobs-rated/best-jobs-2021*

1. Data Scientist
2. Genetic Counselor
3. Statistician
4. Medical services manager
5. Mathematician
6. University professor
7. Operations research analyst
8. Information security analyst
9. Actuary
10. Software engineer

There's probably a few jobs on there you haven't even heard of. Also, seven out of the 10 best ranked jobs require quantitative skills!

There are two main takeaways from this list of the top 10 jobs. First, the skills that a mathematician learns are invaluable to employers. Second, when looking for a job after studying mathematics one should cast the net wide! There is a diversity of jobs, and employers aren't always the best at connecting with the skills they need.

The moral of this story is that if a student is interested in mathematics and enjoys doing it, they can jump right in to that study, assured that the skills they cultivate are rare and valued by employers.

Finding a job

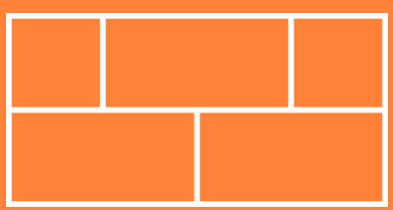
While I won't provide an extensive array of websites one can use to find a job (there are many!), one particularly useful resource for finding a maths job is the AMSI Careers website:
https://careers.amsi.org.au/

It has lists of job ads, graduate programs, and career types, as well as a newsletter for staying in touch with the changing workplace.

Otherwise, attending university career days is always a great way to meet employers and find out a bit about the job market. Another great way of breaking into industry is through an internship – see APR.Intern at https://aprintern.org.au/ for example!

A TOPOLOGICAL PUZZLE

Can you draw a continuous curve across the graph below, such that the curve crosses each of the 16 edges exactly once?



What if you put the graph on the surface of a sphere? Or on the surface of a donut?

A graph is another name for a network, an object comprising vertices and edges.

A WORD FROM THE DIRECTOR

A/Prof Norman Do
NMSS Director

For obvious reasons, the 54th National Mathematics Summer School was run virtually in January 2022. With various lessons learned from our remote program the previous year, the staff were confident that we could deliver a successful NMSS online, Version 2.0.

NMSS staff and students participated online from their respective homes, jumping between the Zoom web conferencing platform for the academic program and the Discord instant messaging environment for the social program. Four courses were delivered across a range of mathematical topics: Number Theory; Algorithms; Patterns and Symmetry Groups; and Counting with Algebra. Tutors used Zoom breakout rooms and all manner of technical setups to help guide each individual student on their mathematical journey. The Experienced Group students did a fantastic job of making everyone feel welcome, preparing a "whiteboard" of "jokes" for each Number Theory lecture and organising various activities, such as recreations of popular television game shows. In addition, we had the traditional Blakers Lecture delivered by a Fellow of the Australian Academy of Science and two talks from NMSS alumni. (Any former NMSS student wanting to return for an alumni talk is more than welcome to contact me at director@nmss.edu.au.)

The summer school seemed to pass by in a flash, but hopefully leaving an indelible impression on every participant. Each year, NMSS staff work hard to provide an environment that enables students to push themselves mathematically and interact with each other meaningfully. However, it is the enthusiasm and engagement of the students that never cease to amaze me and make the National Mathematics Summer School the most rewarding educational environment I've had the pleasure to experience. NMSS 2022 was no different in this regard and I thank all staff and students for that.

ASK ME ANYTHING

This year, the Experienced Group students organized two Ask Me Anything panels, each with four of our own spectacular NMSS Staff. This was a great opportunity for students to ask questions about our panelists' experiences, their hobbies or their passions, what and where to study, or anything else!

Clockwise from top left: Dana Ma, Siksha Sivaramakrishnan, Dr Brendan McMonigal, A/Prof Jonathan Kress

Clockwise from top left: Andy Tran, Dr Melissa Lee, Tom Clement, Dr Merryn Horrocks

NMSS CRYPTIC 2022

By JC, BJ, MM, EM

ACROSS

1 Gun-toter reports big mountain of cigarettes (8,6)

8 Quiet! Fairy returns quiver (5)

9 Oddly ignite ex-German ties and assimilate (9)

11 Paleontologist unearthed long time period (3)

12 Sounds like tap drips onions? (5)

13 Casey will hear her maiden name inside, climb up and hurt her leg (4,5)

15 Regress to be a lecturer (4)

16 Unnaturally deeper verse lyric is within (10)

19 See 19-down

20 I cheat with this symbol (4)

23 Makes fun of Sir Euclid! (9)

27 Statement is broadcast across moon of Jupiter by head of Mercury? (5)

28 Even doodad is strange (3)

29 See 18-down

31 New thoughts for angry aides (5)

32 See 4-down

DOWN

1 Letter to record Spanish agreement with self-effacing lion? (7)

2 Spooner supports mistake for lumberjack (3-6)

3 Swarm during goblin festival (6)

4-,7-down, 32-across Ponder about basic objects that describe this NMSS mantra (5,6,2,6,6)

5 Republican tiger returns for a tool? (3)

6 Would I see a sound argument? (5)

7 See 4-down

10 Alias – known acronym! (1.1.1.)

14 Mythical cricket team out east (5)

17 They left, broken with alcohol (5)

18, 29-across Confused uncle had brainwave while listening to ex-Vice President beat a very fast process (9,9)

19, 19-across Medal winner will spoil root vegetable on old space station while Zak laughs at Japanese pair (6,10)

21 1000 sensei smashed my enemy (7)

22 Sort of out there vegetable! (6)

24 Follow hound (3)

25 Carbon soldier seizes gutless offer, pretty dog (5)

26 Heartlessly morose and confused about demon's centre in historic battle (5)

30 Starts talking over Patrick's head (3)