

The MASS³ Monthly

MONASH ADVANCED SCIENCE & SCIENCE SCHOLAR SOCIETY NEWS

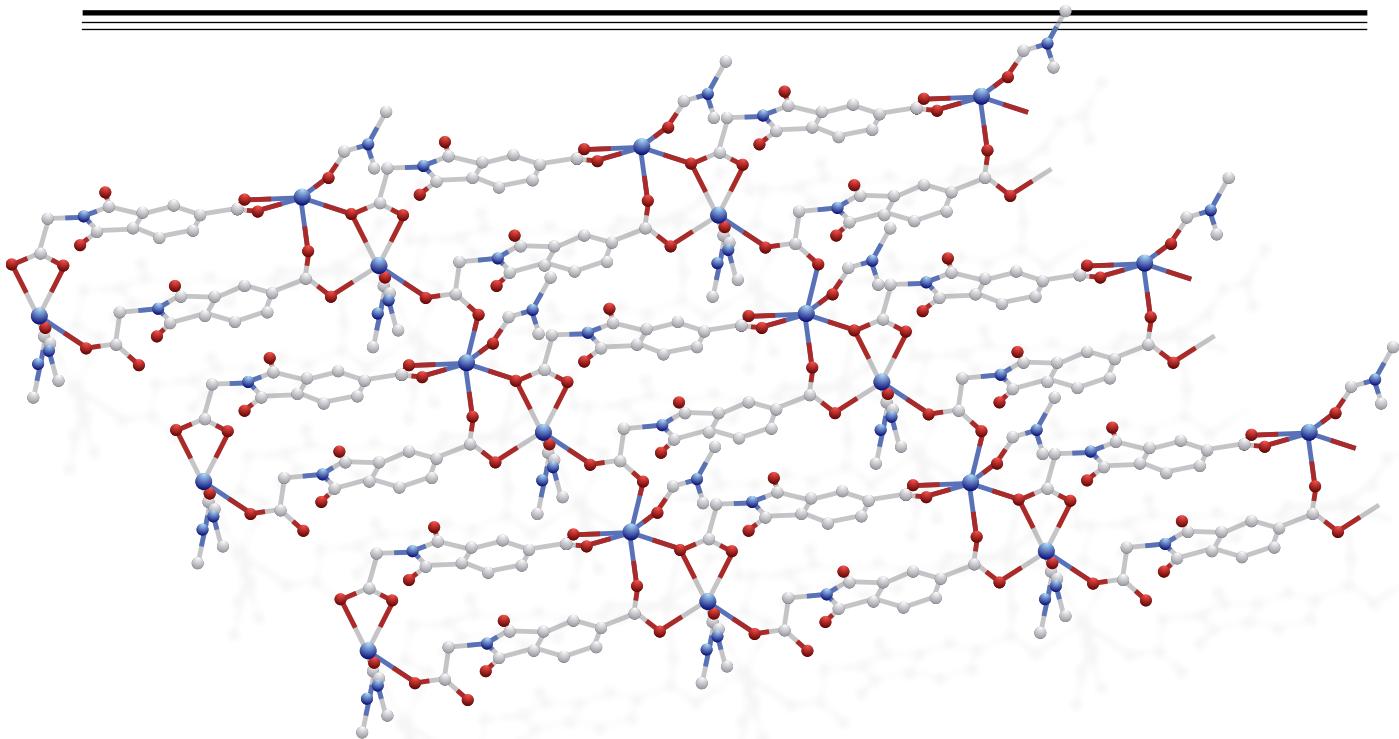


ILLUSTRATION BY CARLOS MELEGRITO
CRYSTALLOGRAPHY BY KEITH BEARDS

Coordination Polymers and Metal Organic Frameworks

Keith Beards gives us some tidbits on his Science Advanced Research Project. (Read it on Page 3)

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MASS³ Community News

IN MEMORY OF JAMES TAYLOR

It seems so unreal to me that a person you've become good friends with suddenly disappear weeks later. It's overwhelming and depressing at the same time— and I can't muster the right words to say in a situation like this. I also didn't want to prelude the newsletter with such tragic news— and many of you may already know what's happened recently:

Fellow MASS³-ian James Taylor has passed away late last week.

He was young, precocious, and only a month in to Uni as a first-year student. His friends tell me that he wanted to study medicine— his talents and biology-know-how showed exactly that— but that didn't stop him from choosing to study at Monash for Global Challenges.

His teachers say that he was curious about exploring the natural world— not just academically, but also through his outgoing, adventurous personality. He was kind, understanding, funny and charismatic— and those that knew him around the common room were wary of his math jokes and ukulele jam sessions. He was the *archetypal* advanced science student.

I've known him only for a few short weeks — but I feel as though we've lost an integral part of our MASS³ community. So,



IMAGE COURTESY OF SUSIE HO

I dedicate this memorial for James Taylor. May he rest in peace— and as he would have told me— re-join the star dust from whence he came.

My condolences to those who were close to James. If you feel the need for some support during these hard times, do make use of Monash University's free counselling sessions, or browse the web for all the services readily available online. And feel free to talk to me— or anyone in the MASS³ Committee if you ever need someone to reach out to.

— Carlos Melegrito, MASS³ Editor

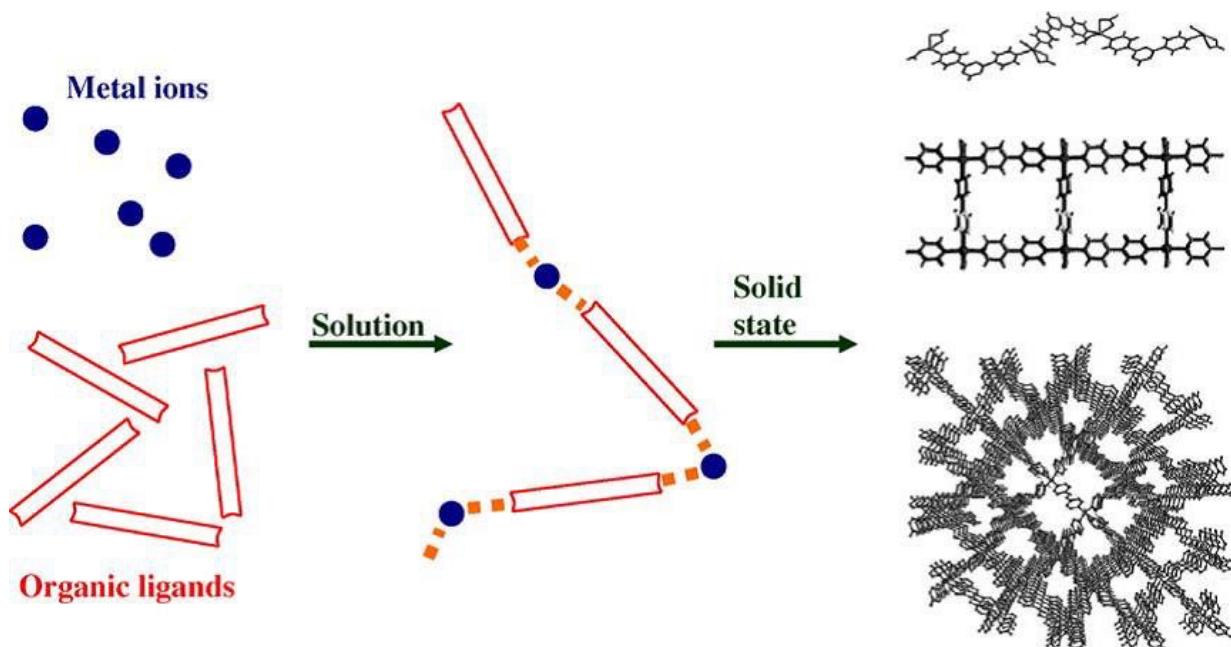
Coordination Polymers and MOFs

A LITTLE BIT OF SUPRAMOLECULAR CHEMISTRY WITH KEITH BEARDS

A lot of chemistry is dictated by the little things – you consider atom X, which is bonded to atom Y, with each of these atoms sharing Z electrons that lead to the W bond. Even if you don't consider that directly, it's often these types of interactions that rule what you're doing. For example, if you're using chromatography to determine how much of a particular sample of petrol is octane, you're using the overall weight and polarity of the molecule to reach a conclusion – two concepts that are dictated by what's happening on the atomic level.

That's where supramolecular chemistry comes into play – instead of thinking of the atoms that are bonded together, you think of the “units” that make up this macromolecule. A protein is a good example of this – a protein can simply be thought of as a group of amino acid residues joined together in a chain (the primary structure). None of these “carbon 1 bonds to carbon 2 bonds to...” annoyances, none of those “the overall molecular orbital of this compound looks like...” headaches.

However, this study goes way beyond just proteomics, which is where my research comes in. Imagine, instead of amino acid 1, amino acid 2, amino acid 3, you simply have two units – a “building unit” and a “linker”. In fact, the macromolecule then is quite simple – just take two building units, put a linker in between, continue. If you do this using metal ions as your building unit, and some organic ligand as your linker, you can have a self-assembly as shown below:

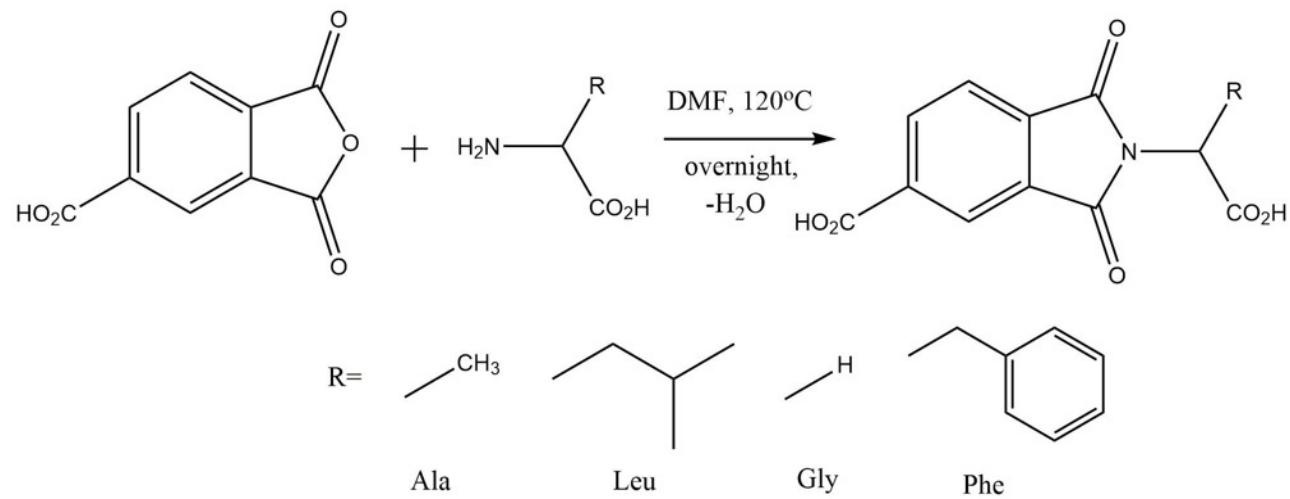


This is what we like to call a coordination polymer. They also get more tricky than that – the building unit shown above is a “primary building unit”, but it could be a “secondary building unit”, in which an ion cluster is used instead to form the structure (for example, $[Zn_4O]^{6+}$ has been suggested before as a potential building unit, some structures show two ions bridged by the linker). Also, properties change greatly based on the type of materials used.

So, the next question is, why do we care? Well, the aim of the game is to make what’s called a “Metal Organic Framework” (or MOF). MOFs are a special class of coordination polymer, which are 3D in nature (so, on the image above on the right, the bottom polymer shown), and also porous (that is, have holes). MOFs have lots of interesting applications – such as your obvious catalysis applications, but also in storage and sensing. Some of my favourites include chiral resolutions (separation of racemic mixtures based on stereochemistry), CO₂ adsorption, and bomb sensing.

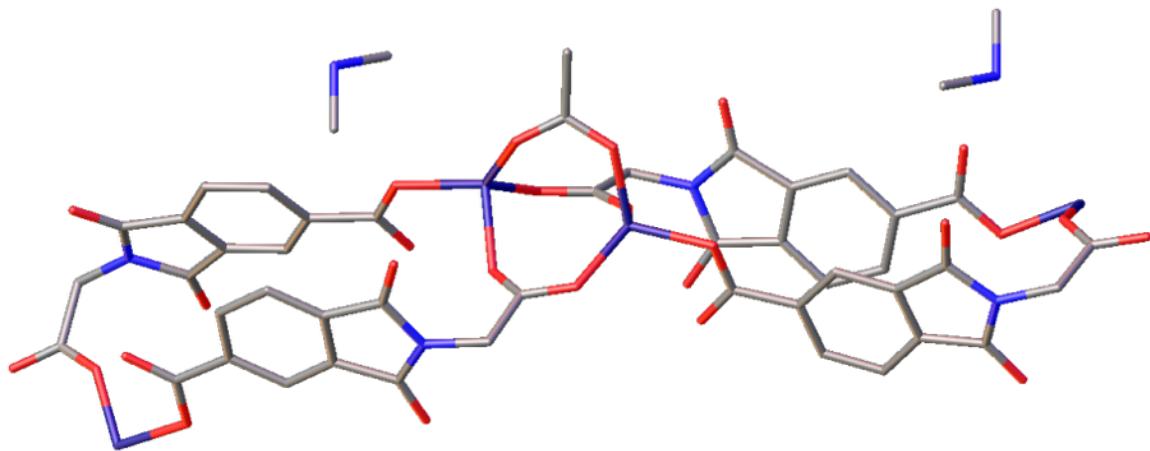
This is where we hit my research project from last semester – aim of the game, make a MOF out of chiral materials that could be used for chiral resolutions. Did I make a MOF? No. Did I learn something new? Definitely!!

The idea behind what we (myself and the research group) did was to use ligands based on amino acids (shown below) as linkers to form a compound that would be overall chiral. However, my supervisor also wanted to see how glycine (that is, the achiral analogue) acted, and from there most of my project became glycine based.

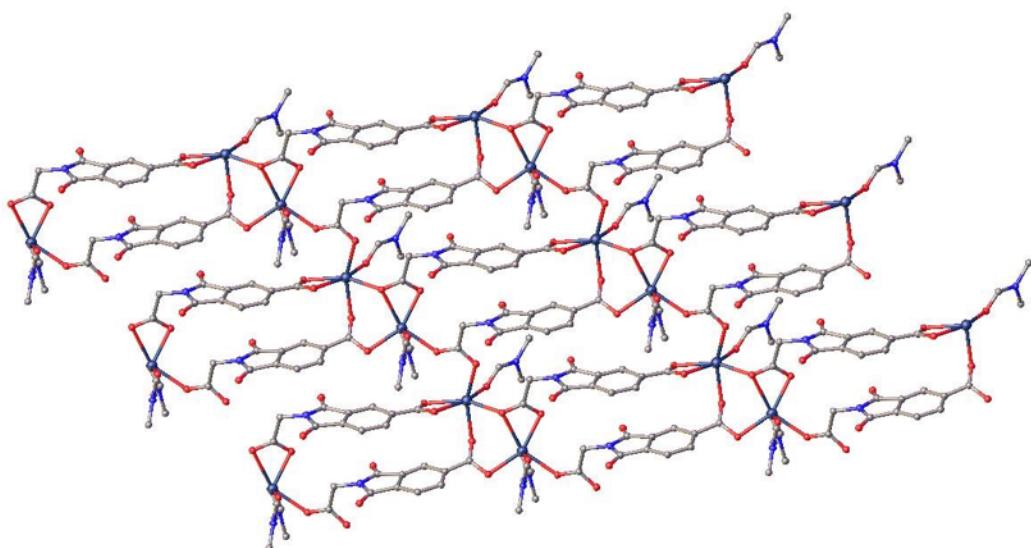


When the polymers were made, a lot of them tended to crystallise out with little effort – one of the advantages of doing things by self-assembly, you’ll often get pure, thermodynamic products, and so the stuff liked to crystallise. The real problem was getting crystals big enough to analyse. Because of this, we’d often take our samples to the synchrotron to analyse them, as the synchrotron could analyse some really shoddy looking crystals. The real bonus was I got to do my own crystallography at the synchrotron – including my dreaded midnight-3am night shift, which ended in me sleeping at the common room for a while.

What I found was a little obvious, but also kind of cool. I got four structures, the first in one dimension, the second in two dimensions, and the last two in three dimensions. Here’s some pictures that I got from the crystallography software:

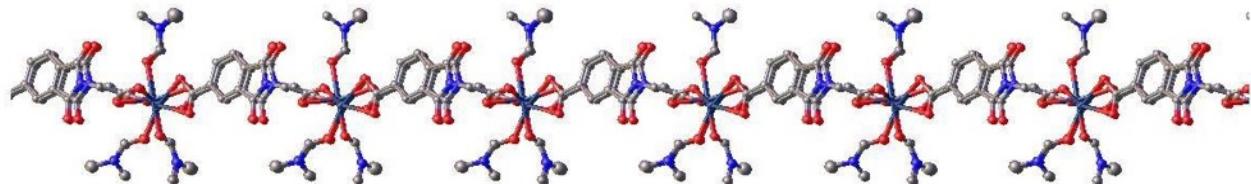


THE ONE DIMENSIONAL CHAIN, FORMED BY THE GLYCINE LIGAND WITH ZINC NODES.



THE TWO DIMENSIONAL SHEET, WITH CADMIUM CHAINS BRIDGED TOGETHER BY THE GLYCINE LIGAND.

What I found from all of this was that as you increase the coordination of the metal centre, the more likely the polymer is to form in higher dimensionality. Seems pretty obvious, right? However, the next bit is a bit cool, and not the most obvious direction. See, this sheet was lined above and below by solvent molecules, as shown below:



So what we did is added a second ligand to the mixture – a “*coligand*”, if you will – which could then act in place of the solvent molecules. This didn’t work exactly as you’d think, leading to a different structure (though not insanely different). However, it did increase the dimensionality of the polymer!

So, what was to be learned from all of this? Well, for starters, the synchrotron is cool – check. However, it also lent itself to why we should care about the smaller discoveries. If a decade or so ago, someone suggested we could increase the dimensionality of these products by taking these synthetic steps I’ve outlined, nobody would’ve cared. But now? We can use those steps to increase the chances of making a MOF, which are very useful to us. So, don’t be scared to discover something “insignificant”, because one day it may become significant.

Sudoku Puzzle (Level: Difficult)

3	5		9		4	8		
	9			8			3	
4		6		5				1
			7	4				
2					6			
		1	5					
8		9		2		7		
9		5			2			
6	1		4		5	3		

How to Play:

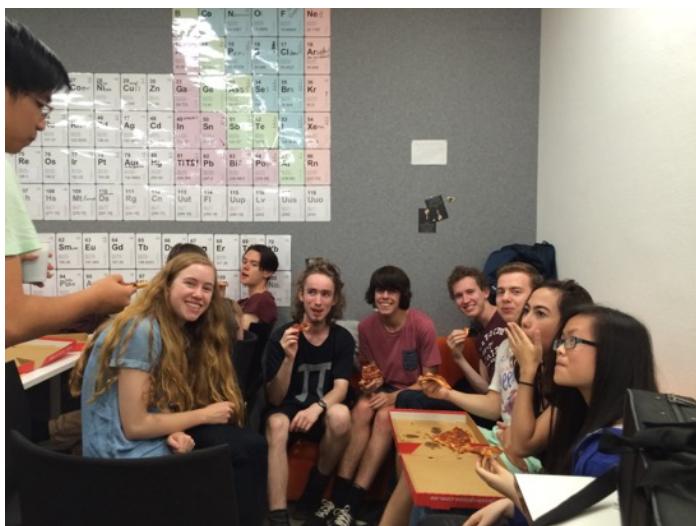
- The objective of the game is to fill the 9x9 grid on the left with numbers.
- Every 3x3 grid, column and row must contain at most one of the integers from 1 through 9.
- Usually, Sudoku games are timed. So take a challenge and try and solve this one under 5 minutes!

MASS³ OGM in Photos

A LOOK AT PIZZA, A FRUIT BOWL AND THE NEWLY-ELECTED FIRST-YEAR REPS



THE PIZZAS ARRIVE, AND OUR COMMITTEE SECRETARY, JACK, ALREADY LOOKS STUFFED



THE LOVELY FIRST-YEARS



CANNOT UNSEE



THE OGM COMMENCES AS THE OVERLORD HERDS THE CROWD



TEARS WERE SHED FOR THE MISSING FRUIT BOWL



BUT ALAS, A REVIVAL



"WHO WILL BE THE FIRST-YEAR RESEARCH REP?" WONDERS BOTH KIEREN & JOSH



THOMAS DELIVERS THE JOKES



CHRIS TELLS IT LIKE IT IS



EVERYONE'S ENJOYING THESE SPEECHES— AND IN THE END, CHRIS BOUNDS WINS THE VOTE!



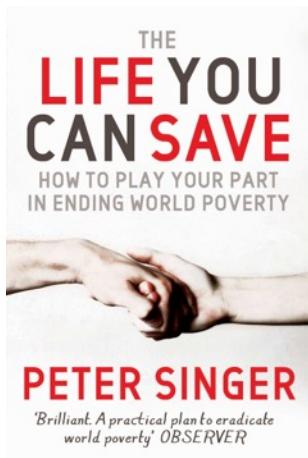
& JO KALDOR PHONES IN AS THE GC REP!!!



AND THERE WE GO. WHAT A NIGHT!

The Life You Can Save – Peter Singer

A BOOK REVIEW BY LUKE THORBURN AND KIEREN WATKINS



When Peter Singer, in the final chapter *The Life You Can Save*, suggests that I the reader should devote a mere 5% of my time and income directly to improving the lives of others, I felt guilty. He was being pragmatic - choosing the achievable better over the implausible best - but in doing so he was conceding the tremendous inertia of the status quo, and granting me a license he had spent the last 150 pages convincing me I did not deserve. Perhaps this was intended. It is more natural to want to exceed the expectations of a moderate authority, than to reach those of an impossibly ambitious one.

To clarify, the book is a cogent Australia-geared manifesto on effective altruism and the ethics of consumption or, inversely, of giving. Readers well read in foreign charities, billionaire philanthropic habits and the paradox of public perceptions surrounding government aid will find that parts of the book tread familiar ground. That said, the strength of the book is not in its originality, but in its setting firmly in the front of your mind a guiding principle too easily neglected. Are your dollars and hours spent on the people who need them most?

Monash CLV (Careers & Volunteering)

SPECIAL THANKS TO OUR SPONSOR

Are you prospecting for a job? Unsure of what your career's going to look like after your degree? Or are you simply look for work that not only looks great on your resumé, pays the bills, but also is within an industry you're academically profound in? Fret no further, because *Monash University* has a service dedicated just for that!

So where do you find it? *LITERALLY* walk a few steps from the common room! Not only do they provide comprehensive information about finding the right job, they also provide workshops on improving your resumé, cover-letter writing skills, and even on-the-spot practice interviews (and more)!

For more information about events, visit <https://www.monash.edu.au/students/career-connect/seminars-events.html?source=careers-connect-home>.

Upcoming Events

MASS³ Trivia Night

- **When:** Tuesday, April 26
- **Where:** Sir John's Bar, Campus Centre
- **Theme:** Age of Mythology
- **Pricing:** Starts at \$5 for MASS³ Members and MSA Card Holders. (+\$5 if not a MASS³ member, +\$5 if not an MSA Card Holder). Tickets sold at the common room, and keep an eye on the MASS³ Facebook group for ticket selling times.
- **Why:** Why not? It's *the* Trivia Night of trivia nights. Join in the fun with a crazy night of facts, questions, and answers! (I probably made that sound way too boring. But trust me, it's gonna be LEGEN— wait for it—

UNIHACK Mini

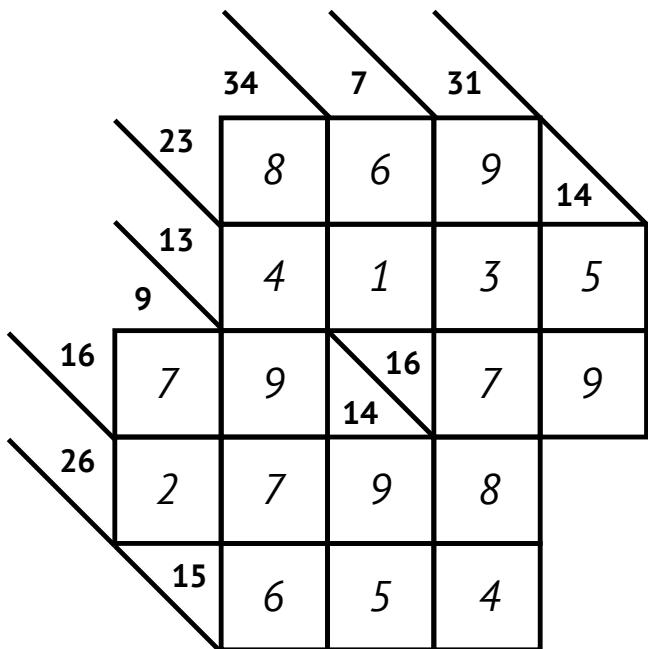
- **When:** The weekend of April 9-10
- **Where:** Registration at the C1 Lecture Theatre on the day
- **Why:** Because technology, computers, pizza, and prizes. It's a must-attend hackathon for those who've never been to a hackathon before. Join in, flex your creativity muscles, and learn-on-the-go as you build software (probably for your first time).
- **How:** Visit unihack.net/mini to find out more about the event.

Comic (Courtesy of Charlie Higson)



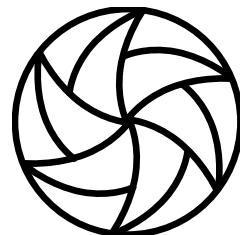
The Answers At The Back

FOR ISSUE II, FEBRUARY 2016



Worded Problems

- **9 digits ordered:** 381,654,729
- **Pizza Slicing:**



- **Fit the coin:** use 3D; curve paper
- **Essay woes:** 15/8hrs together
- **Sinking ship:** it will rise

Questions? Feedback? Comments? Suggestions?

Got a question for the editor, or something you'd like to say about the newsletter? Email cjmeli@student.monash.edu.

Looking to say something to the MASS³ Committee? Contact mass3@monashclubs.org!

Note that while the newsletter strives to present information as accurate and valid at the time of publication as much as possible, there will always be a mistake somewhere. If you spot any, promptly email the editor.