9 770705 041004

"IF YOU COULD TRAVEL TO ANY FICTIONAL UNIVERSE, WHICH WOULD YOU PICK?"

"Hey uknightED, write the **mastHEAD** here." That's right, the **mastHEAD** is going to be written by yours truly, uknightED. It's crazy that I got signed on, but now it means I can not only see behind the scenes for the process of **mathNEWS**, but I can also enact my nefarious plan of the environmental faculty takeover.

The **mastHEAD**'s purpose is generally to open you all up to the issue. It's the beginning, the appetizer and the green light before you really get into the meat of 149.1. Can you imagine that? We're almost at 150 volumes! That benchmark will occur in Fall 2022. For now, though, you're stuck with me, my lecture notes on spatial modelling, and a ton of theories on why Math C&D isn't open yet.

Speaking of, theoretically I can give mini-lectures on urban planning in the **mastHEAD**, but the chances of you actually reading these will likely be overlooked by the rest of the issue, which features short stories, quotes, and all in all funny and informative articles geared towards the Faculty of Math. That's what **mathNEWS** is all about! (Until, as you will read in my manifesto, the environment faculty stakes its claim.)

Did you know that a good chunk of articles from v148.6 are in this issue? The previous prodnight had such an amazing turnout with at least 50 articles, that we had to set some aside for this issue. In a similar vein, cutting room topics from this **mastHEAD** include the previous writer's fate, IKEA furniture and a long-ass story about how I accidentally took a train to Toronto.

uknightED
Editor, **mathNEWS**

ARTICLE OF THE ISSUE

Congratulations to hotfemoid for their winning article *Hollow*!

Come on down to MC 3030 to pick up your secret prize! (It's a gift card, like before.)

god ⚡ peED
Editor, **mathNEWS**

Xx_420SonicFan69_xX	One where Math C&D opens.
Deriving for Dick	Where piss isn't stored in the balls
JEFF	No statistics
boldblazer	"Travelling to fictional universes have been temporarily suspended due to the COVID-19 pandemic. We apologise for the inconvenience."
yummyPi	A universe where I am good at math (big sad moment)
Predap	I dunno, probably Blaseball or something?
Not a N*rd	I already travelled to this one. Thought there'd be more magic.
someBODY	Can't go wrong with Minecraft! But it better not be hardcore mode.
Finchey	This one.
sqrt(cause)	One where the Gaussian Normal Distribution is more of a Dirac-Delta function, that is STDEV = 0.
certified Molasses Enjoyer	Maybe the fictional universe was the friends we made along the way.,.,,.
Prince Charles	England. I mean, they have a queen, that must be made up.
ʊ	One where I've yet to experience PD1.
CUTLET	One in which there are six 28-hour (on average) solar days per week (idea shamelessly adapted from xkcd)
APHF	A universe where every single resident is a traveller from a foreign universe and is pretending to fit in, whilst not knowing that everyone else around them is also from a different universe.
UW Unprint	*The Dark Knight Rises*, but after the ending, so I can just live my normal life except Batman is real.
tendstofortytwo	A universe where **mathNEWS** did not die out in 1986.
Abald Man	Kerbal Space Program
evilevievil	A fictional universe of which one cannot travel to.
peacelovemath	one where I have a more clever answer to this **mastHEAD**
gildED	I'd really like to visit any universe where everyone has magic, just to try some spells— maybe the Forgotten Realms (DnD)!
god ⚡ peED	Chima.
uknightED	The universe where Fuse apexlegends is my bf
terrifiED	The universe where Jerma fans don't exist. *[Editor's note: we're already in the office.]*

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mathASKS 149.1
FEATURING PROFESSOR DAN BROWN

πLLOW PRINCESS: WHERE IS YOUR FAVOURITE TOILET ON CAMPUS?

How do you know that I have a favourite toilet? In any case, it's on the 3rd floor of Chemistry. I had a colleague tell me that he was surprised to see me walking to that bathroom a few years ago, but it's probably the third or fourth nearest one to my office that doesn't involve stairs, and it's much nicer than the ones in the Davis Centre.

FLUFFIEST CACTUS: WHAT ARE THE MOST INTERESTING APPLICATIONS OF PHYLOGENY TO DISCOVERING LOST HISTORY?

I think that work on historical linguistics is a fascinating use for phylogenetics, but it does run a lot of risk of being not quite properly used, since the analogues to "multiple alignment" and "mutation" are hard to identify. There's some lovely work also on integrating molecular phylogeny with paleontology records, that I've always been kind of awestruck by.

I think Bayesian phylogenetics is probably the most useful, but I think more "discrete algorithms"-ish methods like parsimony are more aesthetically pleasing. A long time ago, I studied kinship relationships, including half-sibling relationships, and I offended several biologists by telling them that the reason why I found the problem interesting was mostly because "half-sibling" isn't an equivalence relationship: X can be half-siblings with both Y and Z, but since X might share a mother with Y and a father with Z, Y and Z can be entirely unrelated. (By contrast, "full-sibling" *is* an equivalence relationship: your sisters are also each other's sisters. I mean, technically, it's not: you're not your own full sibling. But still, the important property is the transitivity, which does apply.) This makes the math around half-sibs complicated, but really interesting. It's been a weird trend in my research over the years that I get bored with problems that don't have complexity outside their home domain.

CIX: WHAT IS YOUR FAVOURITE PART ABOUT BEING A PROFESSOR? WHAT IS YOUR LEAST FAVOURITE PART?

My favourite thing about being a professor is the freedom I have to figure out what I find interesting. My least favourite thing about being a professor is probably not something I want to say publicly.

CIX: HOW DO YOU STRIKE A WORK-LIFE BALANCE? PROFESSORS ALWAYS APPEAR TO BE SO BUSY.

I build work-life balance by prioritizing my family after hours, and by trying not to perform busy-ness. I think there are a lot of parts of the professor's job that *can* take up lots of time, but I don't think that always helps.

ENAMOURED: WHAT IS YOUR FAVOURITE FOOD?! ☺

My favourite food is hard sourdough pretzels from my home town of Lancaster, Pennsylvania. Specifically from these people: https://www.hammondspretzels.com/. I have pretzel cuff links.

A FOODIE: WHAT IS THE BEST RESTAURANT IN THE UNIVERSITY PLAZA?

I like iPotato. I am thinking I need to restart http://eatingtheplaza.blogspot.com/, since the Plaza has (not surprisingly!) had a lot of turnover in the past ten years. What's your favourite place in the Plaza? *[Editor's Note: Lazeez is king.]*

EVILEVIEVIL: ON YOUR "FOOD HISTORY" PAGE, YOU WROTE, "I HAVE LEARNED… TO EAT HONEY CRULLERS." IS HONEY CRULLER YOUR FAVOURITE DONUT? IF NOT, WHAT ARE YOUR FAVOURITE AND LEAST FAVOURITE DONUTS?

My most favourite donut is probably the apple fritters from the New Hamburg MCC Relief Sale. I don't like Boston cream donuts, because I find them too heavy.

A FOODIE: WHEN WILL YOU UPDATE YOUR WEBPAGE WITH THE BEST WINERIES IN NIAGARA?

You're right that I still haven't updated my website with wineries! Wine tasting has changed so much in the past several years, and especially since the pandemic started. It used to be that you just went to a winery, and they gave you tons of tastes of wine, and if you bought a couple bottles, you got the whole tasting for free. Now you have to schedule in advance, and pay for it, and you only get to try like four wines, and it's less fun. I like Megalomaniac, and I really like Pearl Morisette, but honestly, the booze I'm most excited about these days is much closer to home: Revel Cider, which is in Guelph.

CLARIFIED: DO YOU STILL SING WITH CHOIRS? HOW'S YOUR SOLO SINGING? WHAT'S YOUR VOCAL TYPE?

I don't sing in choirs anymore, but I keep thinking I should again. The kind of singing I most enjoy is a weird hymn style called Sacred Harp singing, which you can learn about here: https://fasola.org/ I don't sing much solo work, but I'm a baritone.

DANFAN: HOW DOES IT FEEL TO BE THE THIRD MOST POWERFUL DAN ON CAMPUS?

I'm not sure who the most powerful two Dans are on campus! I've had lots of admin jobs over the years; I'm happy being just me these days. It was funny when one of the Browns who had a more senior role than me was Steve Brown, who was an associate dean, since that's the same name as my dad. Steve Brown and I used to do some work together, so I set my email

program to identify them as "Steve Brown (dad)" and "Steve Brown (associate dean)".

DANBROWNFAN: WHAT ARE YOUR THOUGHTS ON DAN BROWN, THE BLOGGER / BASKETBALL PLAYER / RAPPER / RHODE ISLAND GOVERNOR / NONFICTION WRITER?

I don't really have opinions on most Dan Browns, but I will say that when Dan Brown the author was especially prominent, I got scary mail a few times, like weird art projects his fans had made. I didn't like that. My favourite Dan Brown who isn't me is a professor at the University of Washington, who actually has collaborated with Dawn Parker from Waterloo's School of Planning. But he and I have never met.

SKIT: WHAT'S THE FUNNIEST STORY YOU HAVE THAT YOU NEVER HAVE THE OPPORTUNITY TO TELL?

I honestly don't think I have any stories that are funny that I haven't told. My best friendships are friendships built around sharing stories. I'm a little more circumspect with wider audiences. :-)

MOUSE: I'M IN YOUR CLASS RIGHT NOW, PLEASE USE THIS AS AN OPPORTUNITY TO SHARE RIVER WITH THE WORLD :)

You can always link to http://river.institute whenever you like. Honestly, it's sad that **mathNEWS** doesn't include photos of River in every issue. No, I don't really like the personalities of cats, though it has to be said that they're less… needy. River is very anxious. We're on a road trip right now, and we put him in his crate while we went to dinner, and monitored him over Zoom. I don't really love the ubiquity of videoconferencing these days, but this worked surprisingly well.

MC-CHAN

couch

YOU SHOULD READ DRACULA

profTHOUGHTS *149.1*

Here's why: I think it's worthwhile for students in STEM fields to learn about other previous eras in which the world was undergoing rapid change, and consider whether the pace of change we're experiencing really is as unique as we often claim. *Dracula* comes right in the middle of one of those eras.

In particular, consider: in 1860, before the US civil war, and not long before Canadian Confederation, manufacturing was largely not done with interchangeable parts, transportation was only by trains (and largely only in industrial parts of Europe and the northeastern US) or rivers, printing and paper technology hadn't improved a ton since the 1600s, medicine didn't know about blood types (and barely knew about anaesthesia!), and weaponry wasn't much improved from the 1700s. And there was still slavery in both the US and several European empires, including the Dutch. Just 60 years later, at the end of WWI, there were tanks and fighting airplanes, car assembly lines and typewriters and Linotype (look it up, it's amazing!), telephones, and the first antibiotics were soon to be discovered; here in Canada, there was still massive disenfranchisement of Indigenous populations, but immigration from other parts of Europe than the traditional countries that had supplied Canadian settlers was starting to happen. 1919 may be "different," but it's in a lot of ways recognizably like today. 1860 is fundamentally odd feeling.

I think students should explore this transition, and my suggestion is to read the fiction from the time. Specifically, I think *Dracula*, written in 1897, is a book you all should read. (Plus, it's better than most movies that it's inspired.) There's a fear of blood transfusion (which might be fatal due to blood type incompatibilities), near-modern speed of transportation (because of trains and fairly fast ferries), speedy communication, and so on. It's right in the middle of this transition. Also, it's an epistolary novel (written in the form of letters), and those are cool whether they're letters or emails or Facebook comments or texts or whatever. (Here's a much, much more recent example, which is also excellent: https://www.facebook.com/AzureFemme/posts/10224963153413566). You should read *Dracula*. That's my **profTHOUGHTS**.

Prof. Dan Brown

I am Dracula, and I bid you welcome to this issue.

COUNT DRACULA (*DRACULA*, 1897)

FUN BASEBALL METRICS

Baseball is a game full of numbers and statistics. Everyone that has ever watched baseball knows the basic stat of batting average (BA), the probability a batter gets a hit. The concept is easy to understand and is popularized by TV coverage.

However, these stats do not tell the whole story, since getting a base hit is not the only way to make production on the offensive end. For example, taking a walk also contributes to scoring. Moreover, not every hit is equal when it comes to contribution. Obviously, a home run is definitely worth more than a single.

To address these issues, sabermetricians, who study the empirical analysis of baseball, came up with a new metric: weighted on-base average (wOBA). This new stat takes into account every possible offensive outcome, and addresses them with different weights. For instance, the formula for 2013 was:

$$\text{wOBA} = \frac{0.690 \times \text{uBB} + 0.722 \times \text{HBP} + 0.888 \times \text{1B} + 1.271 \times \text{2B} + 1.616 \times \text{3B}}{AB + uBB + SF + HBP}$$

- uBB = number of unintentional base on balls (i.e. the batter was walked due to the pitcher not pitching good enough)
- HBP = number of times hit by pitch
- 1B = number of singles
- 2B = number of doubles
- 3B = number of triples
- HR = number of home runs
- AB = number of at-bats (the batter either got on base from hitting the ball, or got out without a run scoring)
- SF = number of sacrifice flies (the batter got out on a catch, but someone still scored)

With wOBA, we can understand which batters have more production on the offensive end. For pitching and fielding, stay tuned.

_ted_fu

BAD CIPHER 1

Try and solve the cipher using the sample encryption below:

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG
THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG
↓
BAQ LOHWW DKFUV ZFG CXATI YGDR JTD ESKO HYX
JTD YXPMN RRYMB JYS POQLI FVQK BAQ EZFU CFN

Now try and decode: BAQIQ BOJI NFJBDA
Harder cipher (and the answer to this one) coming soon.

Gerald Lee

THE ART OF CHAOS STUDYING

Study regularly. Pace yourself. Stay on topic. Make a schedule. People say these things, but are they really helpful? I've done basically the opposite with great results (and way more free time).

So, what's this "opposite" you speak of? — you might ask. This, my friends, is chaos studying.

Chaos studying means three things: self-understanding, searching, and randomness (duh!).

STEP 1: SELF-UNDERSTANDING

Let's face it: we have our good times and our bad times, and in your bad times, putting all the willpower you can muster towards studying will still get you nowhere.

"Butbut, I'm always feeling bad."

Sure, but no matter what some of your times are better than others. This "clock" might be consistent, or it might not be. The hard question is, "how do you know you're in a good versus bad time?"

STEP 2: SEARCH

There's only one way to go from knowing nothing to knowing something: research. Researching about yourself means trying to study, at random to start with (see step 3), and figuring out what works. If you're into *search algorithms* or *nonlinear optimization*, you can use the things you learn in those classes to experiment on yourself (hooray, applications!). Honestly, any reasonable continuous function will probably work, this is honestly easy mode in terms of optimization.

STEP 3: RANDOMNESS

Do ϵ-greedy, but in real life. If you know what those words mean, you're done the article.

Most people don't know **nothing**, they know things and are stuck in bad habits. How do you break those habits? By randomly breaking from them. For every action you take, have some tiny chance of forcing yourself to change, just to try it out. Follow your instincts. Have friends who randomly interrupt you. If you must, go on `https://www.random.org`.

TLDR: when it comes to learning things, machine learning techniques have a lot to teach us.

imaxblue

ON LOVE

Over these past COVID years, law firms have been reporting notable increases in divorce rates. Sadly, this makes all the sense in the world — for many, the love soured over the time spent together. I don't think it necessarily says much about either party. Sure, maybe we fought. Maybe we didn't talk as much as we should have. Maybe, maybe we just needed a break.

It is to this phenomenon that I attribute my friends' oft-expressed hatred for PD1: they simply spent too much time on it. As such, being someone who has finished the entirety of the course in under four hours, reading absolutely none of the course content along the way, I am naturally the most qualified to expound upon its virtues. Even now as I write this my heart throbs for a time it can never get back. My time with PD1 is better left a cherished memory, I know. I know this. But sometimes, sometimes I see others working away, drafting bullet points and personal pitches, and I cannot help but think: "God, I wish that were me."

A1 — ON SELF (38M34S)

You ask the hard questions, PD1. "Do you know who you are?" But you always have an answer. "You are who I say you are." The first instruction beckons. I open SkillScan.

> **Assess your Level of Proficiency: Use Intuition**
>
> *Act upon insights gained through feelings and sensations.*
>
> [Low Proficiency] [Moderate Proficiency] [High Proficiency]

I close my eyes. I click.

> **Assess your Level of Proficiency: Install/Operate**
>
> *Set up and operate software, hardware, electronics, or equipment.*
>
> [Low Proficiency] [Moderate Proficiency] [High Proficiency]

And I click. And I click. I open my eyes. Who am I? I am dominant in Promote/Sell. I am high potential in Design. I am support in Manage Data. I am less than the sum of my parts. I am summarizable. I am employable. I am who you say I am.

A2 — ON VALUES (42M23S)

You're relentless, PD1. "What do you value?" Much and many, PD1, too much and too many to ever list. Above all though, PD1, I would think that I am the product of those who choose to be around me. And so I would say my family, PD1. I would think the above and say the above if I did not know better. But I do know better, and you know best, PD1, and you know that I know that my values are those of my organization, my goals my career, and my family my coworkers. I value friendships, PD1, you know I wrote that on the question five blank, and you know what I mean. Friendships is management. Friendships is corporate. Friendships is results, PD1, and friendships is you and me.

A3 — ON INQUISITION (11M58S)

Love's a game of chess, PD1, and you and I, we know the same openings. You ask the right questions. I give the wrong answers. "Give an example of a goal you reached and explain how you achieved it. What skills did you use to achieve it?" Once upon a time, PD1, I wanted to be closer to someone. Through my Communication, PHP, and Interpersonal skills, PD1, I was able to over a period of three months increase our relationship strength from a 6.4 to an 8.6, compared to the nationwide platonic average of 8.2. I love your questions, PD1, and you love my answers, though they be wrong, wrong, wrong.

A4 — ON LUCK (07M46S)

I had a pleasant dream, PD1. I carved my flesh onto a platter, PD1, and raised it high above my head. I hollowed myself out in offering to the stars, PD1, I straightened by back, I lifted my shoulders, I strained every fiber I had left, PD1, and at last I was consumed. And I was happy, PD1. God, I was happy.

A5 — ON INDIVIDUALITY (25M04S)

Hello, PD1. This is my name, PD1, but don't you worry, I'll laugh it off when you forget. This is what I study, PD1, this is what I've done, and this is what I do now. I'm interested, PD1, in your company — really, I am! both meanings of the word! — and I ask of you from a friend to a friend: how can I be of use to you? What opportunities can you provide me? And dear me, I must apologize — I didn't go over thirty seconds, did I?

If anyone reading this has access to a copy of PD Office Politics, send it mathnews@gmail.com.

A NOSTALGIC EDITOR

A6 — ON AWARENESS (34M54S)

An emotional intelligence test. You know the drill, PD1. I close my eyes. I complete the test. I open them again. I am Happiness. I am Interpersonal Relationships. I am Problem Solving. These are my Strengths, Strengths for they will Positively Contribute to my Success in the Workplace. But I am not Flexibility. I am not Assertiveness, and I am not Impulse Control. I am Flawed, PD1, Flawed because my traits Negatively Impact my Productivity, which in turn is an indictment of my Character. I am Flawed, PD1, and I pray you continue to be my Strength.

A7 — ON RIGHTS (06M51S)

I have rights that protect me against workplace harassment, human rights harassment, and sexual harassment. I have resources to reach out to should I have concerns. (Unironically) thank you, PD1.

BONUS — ON TRUTH (30M28S)

It's elegant, so beautifully elegant, how sortable we are, how it takes just sixteen buckets to cover our totality. With these four letters of mine, my employers will know exactly who I am and how to optimize my utility, elevating me to my fullest potential and obtaining from me a maximal return on investment. Thank you, PD1.

A8 — ON LOVE (25M23S)

I didn't think it would take this long, when you told me to summarize you, PD1, for your knowledge remains fresh on the tip of my tongue. Though I didn't think it would be over this quickly, when you told me to summarize you, PD1, for your knowledge paves yet the rest of my days.

I wish I'd never met you, PD1, so I could fall in love with you again.

ħɔ

HOW TO FINESSE A CO-OP

There's a reason why we all came to Waterloo, and it wasn't for the culture or student life. It was for that glorious co-op pay check. As yet another cycle of WaterlooWorks approaches, I will try to impart some wisdom based on my experience of co-op searching, as a first year currently on co-op. I would like to note that for first years the pressure especially is on to get **any** co-op, so no shame if these methods are a little shady; it's just business. ;)

1. SEDUCE THE INTERVIEWER

They won't be able to notice your poor resume and non-existent socialization skills behind that megawatt smile and charming personality. Why would they hire another code monkey when they can have you, you fine specimen. And if this whole job thing doesn't work out — well, at least you have a sugar mommy/daddy who will pay your wasted co-op fees.

2. LIE.

I know lying's immoral and all, but let's be honest — your 6-month tenure at Whole Foods and half-assed high school tutoring startup is not enough to secure a real adult job. Some advice that may have worked for me (but I will adamantly deny if asked) is to copy random skills, then learn just enough about them before the interview so you sound credible enough. Then repeat step 1 so they don't notice your bullshit.

3. FINESSE YOUR PREVIOUS WORK EXPERIENCE

Is it signing in elderly people into church or "Information Desk Attendant"? Even better if you managed to get a job through nepotism. You can just make up random roles and put it on your resume. Is it "McDonald's Cashier" or "Store Manager"? A 17-year-old manager may sound like bullshit, but who are they gonna call for reference, your mom?

4. KEEP YOUR LAPTOP ON THE SIDE DURING THE INTERVIEW

Put up a picture of your smiling family who will definitely disown you if you fail your interview. The incentive will make you sweat (with which you will have a dewy, natural glow) and make you thrive under pressure, I think.

5. DO YOUR RESEARCH

Not just on your company, but also on your interviewer. Work in your passion for asthma research after discovering their daughter's asthma problems, or your affinity for bats after learning about their love for Batman.

6. THREATEN THE INTERVIEWER

Okay, maybe don't do this one first, but combine this tip with step 5 (how resourceful of you) and now use this information against them. How did I know your daughter's school address and where she keeps her inhaler? You'll never know ;) Maybe your Batman-like detective skills will impress them enough to stave them off from calling the police, or even worse, CECA.

7. END OFF YOUR INTERVIEW WITH A WINK AND A CASUAL LINKEDIN DROP

Adherence to step 1 is a priority.

*Kaytri.x*

THE ADVENTURES OF PROFESSOR M. GOOSE INTERLUDE

So, this was **going** to be the daring fight scene between Professor Goose (and friends) and the corrupted math student/eldritch horror. Buuttt, the author (me) made a very small (big) error. Everything added in the Professor's spellbook referred to math terms that the author does not understand at all. Like literally zero clue. Like, using Wikipedia while trying to hold on to the last shreds of sanity kind of no clue.

But then, a sudden realization hit: this is **mathNEWS**! There's tons of math students (like me, a real math student) , and some actually know what they're doing (unlike me, a real math student).

What follows below if not a story about goose wizards and cat-related creatures, but just math explained by someone who doesn't like math. That's right readers, you've been bamboozled into reading about real math! (please please please don't stop reading please please please)

Special thanks to people at **mathNEWS** *who understand math:*

So first, you need to learn what an open set is. Since explaining stuff is hard, here is a picture of other people's hard work so I don't have to explain it:
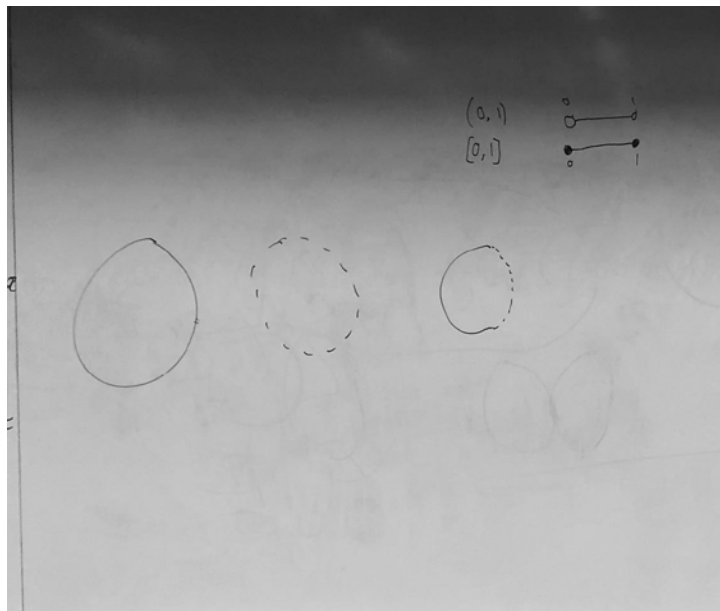
Open set: a set that is open. (0, 1) is open cause it doesn't include any of its boundaries. [0,1] is closed cause it does.

Then you need to learn what a topology is: which is the set of all open sets. This is semi intuitive if you like math. Picture below was important as some kind of generalization but I don't remember, or possibly never knew why.
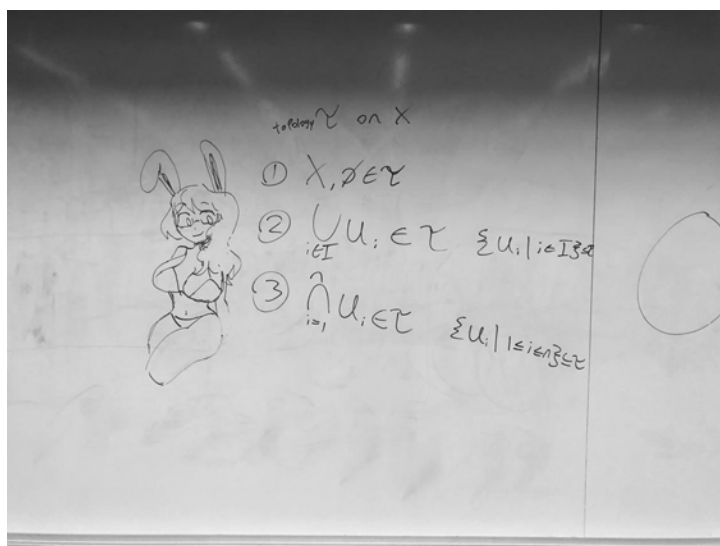
Then you need to know what a group is. Don't make the same mistake as the author and just assume it was like a group of stuff. It is way more complicated ahahahahhahahahahha (help me)

Group Mathematics: has to be associative and closed, every element is invertible.

Group: sets with an operation. For example, real numbers with the operation being multiplication.

Abelian Group: order does not matter when using the operation. Example, 3×4 and 4×3 work the same, but $3 \div 4$ and $4 \div 3$ do not.

And that was all just to explain what a Presheaf is:
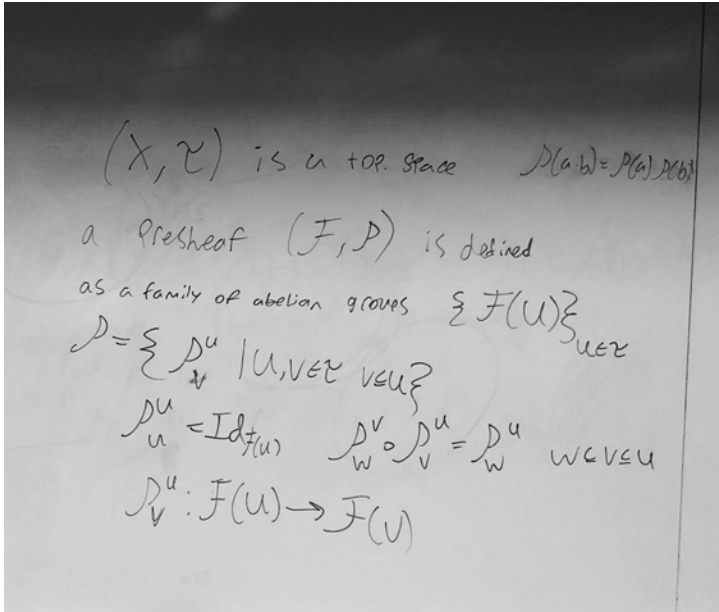
If you understand this good for you. This is not gonna be explained any further due to a lack of the ability to do so.

And this was all finally to explain what Sheafification/Sheafify means:

Dumbed down definition: bunch of groups with associates restriction map. Splits into pieces or something

Real definition:

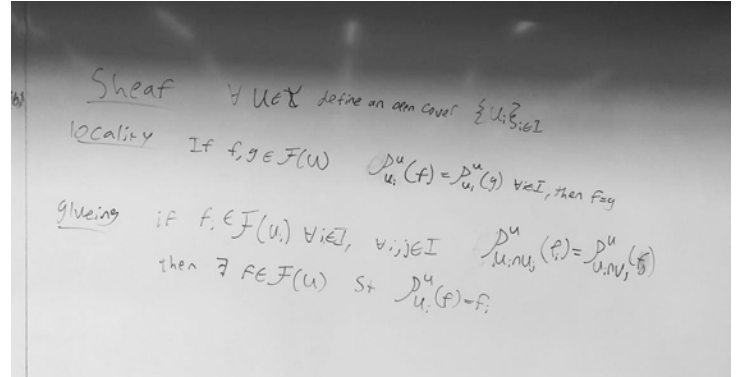(And, this is all because I wanted to write about a goose wizard using magic spells with silly little references to math. Chase your dreams kids)

To be continued…

Not a N*rd
(as I just proved)

Hello fellow math god! Want to decide what happens to ProfessorM. Goose? Come to the next prod night or email your suggestions to professormgoose@gmail.com.

FEDBUS IS TERRIBLE; HOW CAN WUSA FIX IT?

As I explained in 148.4, the FedBus is a lacklustre product with the GO Bus surpassing it in just about every way on its most popular Toronto-bound routes, and providing little to no value to the majority of UW students.

The solution? Cancel all GTA-bound routes — as counter-intuitive as that may seem. The fact of the matter is that there is simply no way for the FedBus to compete with GO, being both worse in every way and more expensive (improving service quality will make the ride even more expensive). Rather, if FedBus seeks to continue to serve the GTA, WUSA should partner with GO Transit to strategically provide additional nonstop service to North York and other high-demand destinations during high demand times. Some good times for additional capacity and/or routes include weekends and before/after exams and reading week.

Does this mean that there is no place for the FedBus to exist? Not so fast. If the FedBus improves its quality of service (by using coach buses instead of low-quality school buses), it can fill a niche where GO Transit somewhat falls short on; trips

not going to/from the GTA. In fact, it could see success in routes to locations such as Aurora, Burlington, Hamilton, and perhaps even smaller towns west of Hamilton by providing trips with much shorter travel times and less transfers than GO by not having to route trips through the GTA. Nonstop trips to Region of Waterloo Airport or Toronto Pearson International may also prove successful during co-op season.

However, the FedBus is not doomed to be a knockoff GO Transit alternative; a third option for the WUSA-run bus line would be to provide ultra-long haul services to cities like Ottawa and Windsor. In those cases, the competition is not a fiercely competitive, government-run commuter transit agency, but rather VIA Rail, Air Canada, and WestJet. In these cases, the FedBus can undercut the airlines and VIA Rail with cheap, sub-$100 fares. This would provide a decent, highly competitive and attractive offering and provide great value to those living far away from Waterloo.

tokyocatboy

POWER QUERY M OR: HOW I LEARNED TO STOP USING FORMULAS AND LOVE EXCEL

If you've ever tried doing any sort of serious or drawn-out data transformation in Excel, it's a pretty safe bet that you've encountered what I like to think of as "tradition creep" that permeates Microsoft Office. In particular, I'm talking about Excel's standard functions and formula language — you know, **SUM**(A1:A10), **STDEV.P**(B1:B5), and the like. These functions seem to work just fine for basic tasks until you need to do anything remotely related to text (or ranges, or dates, or booleans)[1]. Have you ever wanted to count the number of times a particular substring appears in a cell's value? We turn to Microsoft's official Excel documentation for answers[L1] (interestingly in the "Office Products Troubleshooting" section…): the formula to count the occurrences of a single character x in a cell is **LEN**(cell)-**LEN**(**SUBSTITUTE**(cell, x,"")).

Now, this alone is kind of ridiculous. To count occurrences of substrings in the most used spreadsheet system in the world, we remove all instances of the substring and find the resulting difference in string length? Okay — let's let it slide for now. How do you do it for more than one character? We have to divide the previous expression by the length of our substring or else it'll be a length-multiple of our real answer. The formula to use for a substring s is (**LEN**(cell)-**LEN**(**SUBSTITUTE**(cell,s,"")))/**LEN**(s).

If what we had before was ridiculous, this will quickly approach ludicrous if we let it continue. We now have to write the same substring twice in our formula just to get it to work! Putting the substring in a cell to refer to won't work because you'll still need to keep track of the cell's address, unless you keep a designated "substring argument cell," and that's just such a hack. There has to be a better way!

I bring to you Excel's best-kept[2] secret — Power Query M, a functional language that operates in the "Queries & Connections" part of Excel. M is designed for many types of data transformations, from simple reshaping to joins to mapping functions over data, but Excel really highlights the simpler and more commonly used features. It seems to me that most M users don't really know they're using M, or don't know much about it, since it's wrapped by a GUI that abstracts details away for more casual users (more on that later). But those who use M in earnest will find:

- First-class functions…and interestingly, built-in first-class tables?[L2]
- Recursion, closures[L3]
- Straightforward, understandable syntax
- A set of mostly sensical primitive types! As well as associated built-in functions[L4]
- Functions to pull data from all sorts of data sources[L5] (SQL, ODBC, XML/HTML, JSON, Azure, Sharepoint, HDFS, and interestingly, even RData file content)

That first point is what stood out to me more than anything else. Tables as first-class values can be passed around, transformed, mapped/folded across, and filtered, all in a functional, natural-feeling way. Let's see it in action:

We have these tables, one of students and their home addresses and one of their grade averages:

id (TEXT)	year_ enrolled (NUM)	street_ num (NUM)	street (TEXT)	city (TEXT)	postal_ code (TEXT)
			…		
salm2	2019	7	Real St	Toronto	M5J 1E6
tuna11	2020	213	Factual Ave	Manhattan	10011
trou3	2019	343	Exists Blvd	Paris	75010
			…		

TABLE 1: addresses

id (TEXT)	grade_average (NUM)
	…
tuna11	72.3
salm2	88.7
trou3	61.9
	…

TABLE 2: grade_averages

Now let's say all students in our school graduate 4 years after enrolling if they have a 65 or better average, and we want to send home warning letters to those who graduate next year but have a failing average. We'll need to first join our tables on the student id column, then filter on graduation year, then on grade average, and lastly, return mailing addresses for those who are getting a warning:

```
1 let
2   joined = // join our tables
3     Table.Join(addresses, "id",
4       grade_averages, "id"),
5   this_year = Date.Year(DateTime.LocalNow()),
```

```
 6    // "each" creates an anonymous function of
 7    // one variable named "_". If "_" is a
 8    // record, then its fields can be accessed not
 9    // just by "_[field name]" but also the
10    // shorthand "[field name]":
11    graduating_next_year =
12      Table.SelectRows(joined,
13        each this_year = [year_enrolled] + 3),
14    failing =
15      Table.SelectRows(graduating_next_year,
16        each [grade_average] < 65),
17    // Fold left! Just creates mailing address.
18    // "&" concatenates text
19    str_and_join_by_spaces =
20      (lst) ⇒ List.Accumulate(lst, "",
21        (acc, s) ⇒ acc & " " & Text.From(s))
22  in
23    // Map mailing address creation across our
24    // table, this returns a list of strings
25    // Lists are written as {foo, bar, ... }
26    Table.TransformRows(failing,
27      each str_and_join_by_spaces(
28        {[street_num], [street] & ",", [city],
29         [postal_code]}))
```

…

---

343 Exists Blvd, Paris 75010

…

QUERY AND RESULT FOR *LETTERS_HOME***:**

Everything just makes so much sense. There's no need to fiddle with age-old hacks which seem unlikely to be given sane alternatives any time soon, lists are first-class values instead of ranges that require array formulas to work[3], we can pull in previously defined tables (they don't have to be defined in this same program! They can be the returned values of other M programs or pulled from Excel ranges)—you can see I'm a fan.

This is an admittedly simple and contrived use case. Why wouldn't I just use Jupyter Notebook? The truth is…I don't truly believe this is a top competitor to certain environments which lead the pack today, especially Jupyter Notebook. After all, if you're used to `pandas` in Python or R's tidyverse packages, this top-level table transformation approach sure feels a lot like dataframes. There's something more to Power Query M, and it's not something we've seen yet or will see now. It's potential—the potential to go beyond data transformation and into data engineering. I'm thinking about two things here: database design and extract-transform-load (ETL) processes.

If you've ever had to design a database schema, there's a good chance you've had to consider which constraints to impose or data validation steps to add in. These steps can be implemented in the schema itself as SQL triggers (I'll assume you're using SQL) that run on certain events, such as before row insertion, but triggers are very finicky and not portable between different SQL dialects. Data validation is instead more usually implemented at the application layer, the context from which you are interacting with the database, since you tend to write your application in a language and ecosystem that make it easy to pre-process data. A concrete example would be an app that inserts a record into a SQL schema's user info table, but only after checking that the domain of the user's email address is in a certain allowed set. Using a proper language like M (and compared to SQL stored procedures, M *is* proper) would let you take data validation and pre-processing into the data management component of a project. It might even be the case that if SQL triggers and stored procedures were more usable and feature-rich, this functionality would *tend* to be implemented on the schema side.

As for ETL: the three steps of extract-transform-load data processing pipelines involve two steps that are devoted to just pulling and pushing data. Arguably, the real magic only happens in the transform step. If your data schema lives in a rich environment with rather natural data transformation capabilities, why ever even have the data leave it for processing? Why not do it in the environment that the data is already in? There's no need for a different platform to extract it to just for transformation if we can work with it where it already is, and we can avoid loading it into a different system that way too. This is really what we did with our letters-sent-home example: we kept things simple and wrote our program on the database side in the form of a query that has immediate access to our original data sources. Of course, you'll need to extract at the start somewhere and load at the end somewhere for any pragmatic data pipeline, but I think that the coupling of application logic and data management in Excel's query system is an interesting choice that may hold merit as a pattern for new DBMSes along with the many applications that rely on them.

Anyway, returning to the grim clutches of reality, it's worth noting that there are a few caveats to the underratedness of Power Query M. M suffers from an incredibly limiting environment and extremely little modularity. To write M programs, you first need to open that previously mentioned GUI, which is the main interface for editing queries (and is only available on Windows). It offers panels full of buttons for common needs, like filtering of rows by some out-of-the-box conditions like duplicate values or blank rows, grouping/aggregating data, substring/string splitting across a column, adding custom columns (you can choose from recipes or write custom columns in M in a pop-up box!), and more. But if you need to do any serious work, you need to open the "Advanced Editor," where you can write M straight-up. This editor is basically a text box with some autocomplete and linting functionality, but that functionality is quite limited. There are also issues when [alt]-[tab]-ing between the editor and the documentation in your browser, which worsens the experience significantly. There is no importing or exporting of modules that I know of, so functions can only be defined either as top-level queries themselves or copy-pasted—but I haven't finished playing with all of M's features and may be surprised

on this count. There's lots of room for improvement, but it is a useful, functional language hidden behind the curtains that Excel likes to keep mostly drawn for the casual user's benefit.

At the end of the day, even if it really does make sense to just pull up Jupyter Notebook, what matters about Power Query M isn't whether it's what makes sense to use right now or not. It's really about the thoughts that it introduces in its unusual existence, and almost more importantly, the opportunities to poke fun at Excel. I hope to explore both of these further in the future.

blinchik

A final side note on the fairness of bullying Excel: M doesn't have a function to count substrings either, just like standard Excel formulas! But you can just prepend an M query with:

```
let count_substr = (str, substr) ⇒ List.Count(
↳Text.Split(str, substr)) - 1 in
```

…which is at least easier to understand than the corresponding Excel formula.

1. To be fair to Excel: the weird, unpredictable, or just limited behaviour that Excel exhibits is matched by its many inbuilt tools and technologies that get around these restrictions, but many of them require manual input or worse: custom solutions in Visual Basic (VBA).[1,6] I'm sure there are useful features that I'm not yet familiar with, but this fracturing of functionality is not very intuitive for the user.
2. Truthfully, I'm not sure how many people are aware of it, but it hasn't been code-golfed yet on Stack Exchange, if that counts for something.
3. Array formulas are entered in Excel by entering the formula using [ctrl]-[shift]-[enter][1,7] instead of just [enter]. Doesn't it just feel wrong to have semantic differences between formulas depending on how you finalize them? Google Sheets is better in this regard—you wrap expressions in the **ARRAYFORMULA** function—but last I used it, it was iffy with boolean functions like **OR**….
L. The links used in this article can be found written out at: https://tiny.cc/pqmlinks

mathNEWS is love,
mathNEWS is life,
I would like to have,
mathNEWS as my wife,
And in our bond,
There'd be no strife ♡

A LOVESICK mathNEWS EDITOR

THE LAST THINGS I DID AS MATHSOC VPA

I was the MathSoc VPA last term, and a few things happened at the very end of the term I wanted to let students know about.

MathSoc's advocacy to get a ban on proctoring software in the Math Faculty was successful, and that ban is now in effect.

MathSoc advocated to reform work term reports, and this term (almost all) Math students on a co-op term will not have to write a work term report. Hopefully the Faculty will decide in Fall to make this change permanent, and I expect that they will.

Vincent Macri
Winter 2022 MathSoc VPA

J-1 THINGS I DISLIKE ABOUT BEING NOCTURNAL

- Not as much is open/active
- I keep unintentionally disturbing people in my household when they're trying to sleep
- Sunlight makes me sleepy (cat-mode activate)
- Although I have the time to potentially be "productive", I more often than not just take the time to relax
- The world is more diurnal

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K+1 THINGS I LIKE ABOUT BEING NOCTURNAL

- The relative peace and quiet
- Time to myself without the added pressure of other eyes on me
- The moonlight is not as harsh as the sunlight
- More creatures are active and visible at night (SO MANY BUNNIES <3)
- The feeling of space and flexibility that I have with my time, as there's rarely any deadlines I have to panic about during the night

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HOLLOW

Gritty blues played from speakers around the bar. The bartender was cleaning glasses while he imagined himself fighting with his twin brother, his mouth unconsciously making the shapes of the insults he would've hurled. Out of the corner of his eye, he watched a young woman sleeping peacefully. She sat on a stool with her head and arms strewn over a small table, inches away from the active pool table. Sometimes, someone would pull back a pool cue far enough that it would pick up strands of her hair for a moment.

The girl hadn't had any drinks, at least none from the bartender. In fact, he hadn't seen her come in and sit down at all. He had turned his back and the girl had apparated into the stool, already fast asleep. The bartender mixed juice and water into a tall glass and walked it over to the girl. He placed it on the edge of the table, and thought for a second if it would be right to disturb her. Before he could come to any conclusion, she woke up.

It was a face he had never seen before. Her eyes were large, and widened further as she looked around the room frantically. She got up from her seat and pushed the stool back in, studying herself and the room. Her fingers slowly raised to her head, and she began to palpitate her right temple and blink her eyes erratically.

The participants of the pool game stopped playing, each of them separately noticing the girl's appearance from nowhere. There were two women at the pool table. The first had peroxide blonde curls and eyeliner well below where one puts eyeliner. The second was a thin woman with crepey skin and thin gray hair pulled into a bun.

"Hi. I'm not very sure of where I am."

"This is Tom's pub," said the woman with the curls. "On Center street."

"What is your name, dear?" asked the woman with the bun.

"Jane."

She paused for a moment to remember how she knew her name was Jane. She had just woken up from a long dream, and the harder she tried to think about what happened before the dream, the less she could recall at all. The more she stood there, talking to these people, the less she would remember.

"Do you have someone we could bring you home to?"

"You know, I think I might walk home."

"You'll be alright? You know your way?" asked curls as Jane opened the door.

"Yes, it's all coming back to me now."

The street was not like anywhere Jane had ever been. There was no place for a car to go; instead, there was a cobblestone path that separated the two rows of facing stores. The shops had signs of metal or cloth, not plastic. In between buildings there were trees that bloomed bright purple flowers.

I am very certainly high. There is something very wrong happening. She stopped underneath one of the trees and looked up at the flowers, which swirled counterclockwise. *Flowers do not usually do that, Jane.*

The longer she looked at the flowers, the more removed she was from the world around her, until she began to see things lost in her mind. *I'm very young, and I'm in a church pew. My hands are clasped together and my eyes are shut tight. I can feel someone further down the pew jiggle the knee rest.* The vision was so vivid. The flowers stopped swirling, and then slowly began swirling again, this time clockwise. Then the next: *I'm a teen, I'm fighting with my parents, and I start sobbing. I scratch my legs over and over again because I can't feel them.* Jane began to feel another vision coming on, and she looked away from the flowers. It stopped.

Across the street was an apartment building of two stories. The door slammed open, making the thin iron rails of the porch vibrate rapidly. A woman walked out. She wore a white fur coat with marbled buttons. Her hair was white too, unnaturally so. She couldn't have been older than thirty, with dark, dramatic features. Jane watched her pull out a matchbox and a small tin. She produced a long cigarette from the tin, and leaned on the railing to smoke, the hem of her coat rising to expose white kitten heels.

She and Jane made eye contact. The woman tilted her head and Jane followed the gesture like two cats watching each other through a window. The woman put out her cigarette on the railing. She returned it to the tin half-burnt, and walked across the street.

"Hello," the woman said. She had a deep voice. "My name is Bunny."

Bunny extended her hand to Jane, who clasped both her hands around it.

"Hi, I'm Jane."

"So, Jane. Are you from around here?"

"I don't think I am."

Jane tried to come up with the words to explain her situation, but Bunny spoke before she could come up with anything.

"I saw you looking at the flowers." She reached up overhead, and plucked a single flower. "My choice, putting forget-me-nots in the plaza. Do you like?"

Jane looked down at the flower. Its petals moved around the base still, pulsing in and out as it moved.

"I'm from Ameritine," Jane said, a single thought coming to her as she watched the flower. "I wasn't sure until now, but all my life I've lived in Ameritine."

Bunny smiled and flicked the flower onto the ground. "The flowers are good for remembering things. Would you like to come in for some tea?"

"Yes, please."

Bunny and Jane walked to her porch. Bunny had the mannerisms of every friend Jane had ever seen as a sister, and the dregs of her memory put her at ease around Bunny.

"You're going to have to excuse my husband. He can be a little neurotic when he has work obligations."

The interior was brick. The walls had been obscured by paintings, cloth hangings, and collages. A wooden chair being used as a coat rack had been painted over many times, currently sporting jewel tones. The living room was at the front of the apartment, where Jane could see two bookshelves and a violet velvet fainting couch. Bunny led her past the living room, into the kitchen.

The kitchen cabinets were painted mint green. There was an oven in the wall, a gas stove, and the sink, which were all white. Everything else in the kitchen was some shade of blue or green. Bunny retrieved a kettle from a cupboard and began making tea.

"Sit down dear," she said to Jane, pulling out a chair from the table.

"Honey! I have company here," Bunny called to a staircase outside the kitchen. A sigh was heard from upstairs, and footsteps followed. A lanky man in a linen shirt and pants walked down the stairs and into the kitchen. He was stretched in the z-axis but still shorter than Bunny. In fact, one would not notice how tall Bunny was until she stood beside her husband. He smiled awkwardly at Jane, and turned to Bunny.

"Leonard, this is Jane. I met her across the street."

"Hello Jane. Pleasure meeting you." He stuck out a clammy hand which Jane shook.

"Hello," Jane was going to return the niceties, but Leonard had already turned to Bunny.

"You must excuse me Jane, I need to have a quick word with my wife." Leonard excused himself outside as Bunny smiled at Jane, mouthing the word *neurotic*. They walked to the living room, where Jane could not hear their whispers. When they came out, the matter seemed to be settled as Leonard sat in the chair across from Jane.

Bunny poured hot water into several small teacups, and filled small cheesecloth bags with dried leaves and flowers in glass jars on her windowsill. She placed all of the teacups on a platter, and spun around to place them on the table in front of Leonard and Jane. Bunny took a seat beside Leonard and placed a teacup in front of Jane.

"This is forget-me-not. Helps with the memory. Won't be as intense as what you saw outside because it comes from dried leaves. Would you like a biscuit to dunk it in?"

"Yes, please."

Bunny pulled a biscuit out of a ceramic jar and placed it on a saucer on the table. Jane picked up the biscuit and dunked one edge in the tea, then took a bite out of the saturated edge.

"Just try and recall what you did this morning."

Jane nodded, but she couldn't remember anything. She repeated dunking and biting until she had finished the biscuit.

"I can picture a room, I think my bedroom. The walls are blue, and there's a canopy above the bed."

Feeling less cautious about the tea, she took a sip.

"I think that's where I was before. I had to run home. I'm not sure why, but I think I was being watched by someone. I'm not sure if it's a dream I'm remembering or my real life."

Another sip. "Then I think something bad happened. I'm not sure what, but I got into my room and felt like I might pass out. I'm an easy fainter, so I crawled into bed. When I woke up, I was in the bar."

Jane took the last sip in the teacup. "Before I felt faint, there was something I had come into the room for, and I was really afraid that someone was watching me. But as soon as I walked into the room, I headed into bed."

Bunny nodded, and replaced the teacup in front of Jane with another. "This is green lilly. It's great for relieving nerves."

"Could I have more of the forget-me-not? I think it was helping."

"No, not now. Most of the time when we forget things, there is a good reason. Too much forget-me-not at once can be pure suffering."

Jane nodded, and Bunny placed tea cups of green lilly tea in front of herself and Leonard.

"I know I can't remember anything, but this all feels too foreign. I don't think flowers usually do that."

Leonard spoke up now: "I don't want to put any ideas in your head, memory is a funny thing. But if you can remember, where do you live?"

"I think Ameratine. I can remember the name, but that's a whole continent or country I think."

Leonard nodded. "Bunny, get me my notebook."

Bunny ran upstairs and came back with a notebook and a pen.

Leonard opened to a blank piece of paper, and drew out a big circle.

"Humour me for a moment please. Imagine that this is the earth. Could you draw some buildings and people to live there?"

Jane looked at the circle. She drew two houses and two people on the outside of the earth, then passed it to Leonard.
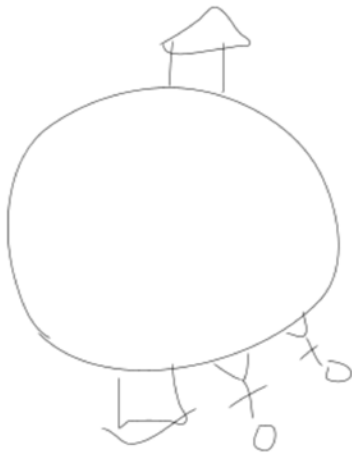
Leonard looked at the drawing for a moment and showed it to his wife. Her premonition had paid off this time.

"Bunny. Phone the mayor and tell him he needs to get here now. Tell him not to bring anyone," Leonard told his wife as he put down the drawing. He ran to the front of the house, and Jane heard the deadlock snap into place.

"Don't freak out. We're going to get you home," Bunny assured Jane as Leonard ran around the room closing the windows. Bunny dialed the powder blue landline bolted beside the kitchen door frame. Jane listened to Bunny's half of the phone call.

"Hello, may I speak to Mayor Jackson? Yes, it's Bunny. Hi Emma, I was wondering- No worries, it's my pleasure. If you could put the mayor on the phone, it's a bit of an emergency. Oh, no, Leonard is fine. He's more than excited for the election tonight, he just needs to speak with the mayor. Thank you Emma!"

Bunny tucked the phone into the crook of her neck as she put on another kettle.

"Liam. It's Bunny, you need to get here now, alone. It's an emergency. I wouldn't call if it wasn't completely urgent, you know that. Yes. Thank you."

Jane was lost, searching for something wrong with the picture. What did I get wrong? The houses go on the outside, that's common sense. The Earth below, the sky above. They don't need to call the damn mayor for me.

Let me look outside the window now. Yes, below there is grass. And above…

Jane looked up. The sky was orange like it was sunset, just as she had seen earlier. But now, as she focused on finding the sun, she realized it was nowhere. Instead, a constant warmth radiated down, as if it surrounded every inch of the atmosphere.

There is no sun.

Jane looked towards the picture.

If this isn't the outside of the earth, it must be the inside.

hotfemoid

EPISODE 37: SYSTEMS OF LINEAR EQUATIONS

Enjoy Episode 37 of the MathSoc Cartoons series: MATH 136 — Systems of Linear Equations!

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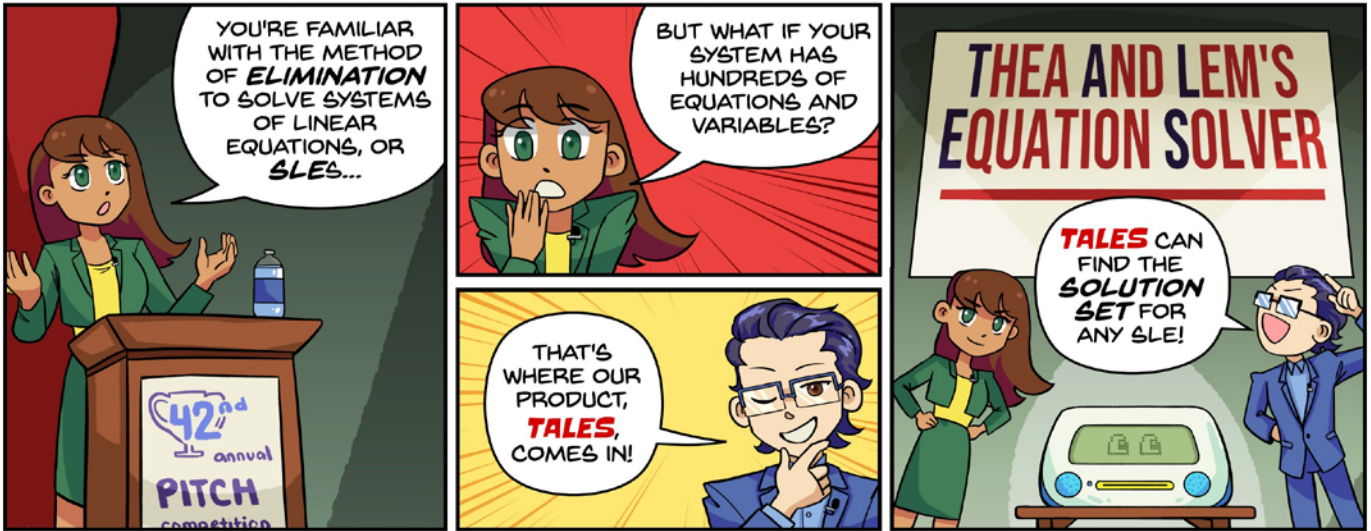

MathSoc Cartoons

MATH 136: SYSTEMS OF LINEAR EQUATIONS

STORY & ART BY CLARA XI

YOU'RE FAMILIAR WITH THE METHOD OF **ELIMINATION** TO SOLVE SYSTEMS OF LINEAR EQUATIONS, OR **SLEs**...

42nd annual PITCH competition

BUT WHAT IF YOUR SYSTEM HAS HUNDREDS OF EQUATIONS AND VARIABLES?

THAT'S WHERE OUR PRODUCT, **TALES**, COMES IN!

THEA AND LEM'S EQUATION SOLVER

TALES CAN FIND THE **SOLUTION SET** FOR ANY SLE!

TALES stores SLEs as matrices...

SLE:

$$x_1 + 2x_2 = 0$$
$$3x_1 + 4x_2 = 2$$

Matrix:

$$[A \mid b] = \begin{bmatrix} 1 & 2 & | & 0 \\ 3 & 4 & | & 2 \end{bmatrix}$$

coefficient matrix

augmented matrix

...And to simulate elimination, **TALES** can perform three **elementary row operations** (EROs).

cR_i : multiply row R_i by a non-zero scalar.

$$\begin{bmatrix} 1 & 2 & | & 0 \\ 3 & 4 & | & 2 \end{bmatrix} \quad 2R_2\sim$$
$$\begin{bmatrix} 1 & 2 & | & 0 \\ 6 & 8 & | & 4 \end{bmatrix}$$

$R_i + cR_j$: add a multiple of row R_j to R_i.

$$\begin{bmatrix} 1 & 2 & | & 0 \\ 3 & 4 & | & 2 \end{bmatrix} \quad R_2 + R_1\sim$$
$$\begin{bmatrix} 1 & 2 & | & 0 \\ 4 & 6 & | & 2 \end{bmatrix}$$

$R_i \leftrightarrow R_j$: swap rows R_i, R_j.

$$\begin{bmatrix} 1 & 2 & | & 0 \\ 3 & 4 & | & 2 \end{bmatrix} \quad R_2 \leftrightarrow R_1\sim$$
$$\begin{bmatrix} 3 & 4 & | & 2 \\ 1 & 2 & | & 0 \end{bmatrix}$$

Like elimination, applying EROs gives you new SLEs that are **equivalent** to the original. That is, their solution sets are the same.

$$x_1 + 2x_2 = 0 \;\text{①}$$
$$3x_1 + 4x_2 = 2 \;\text{②}$$

eliminate x_1 from ② (② − 3①)

$$\begin{bmatrix} 1 & 2 & | & 0 \\ 3 & 4 & | & 2 \end{bmatrix} \quad R_2 - 3R_1\sim$$

$$x_1 + 2x_2 = 0 \;\text{①}$$
$$- 2x_2 = 2 \;\text{②}$$

isolate x_2 (½②)

$$\begin{bmatrix} 1 & 2 & | & 0 \\ 0 & -2 & | & 2 \end{bmatrix} \quad \tfrac{1}{2}R_2\sim$$

$$x_1 + 2x_2 = 0 \;\text{①}$$
$$x_2 = -1 \;\text{②}$$

eliminate x_2 from ① (① − 2②)

$$\begin{bmatrix} 1 & 2 & | & 0 \\ 0 & 1 & | & -1 \end{bmatrix} \quad R_1 - 2R_2\sim$$

$$x_1 = 2 \;\text{①}$$
$$x_2 = -1 \;\text{②}$$

$$\begin{bmatrix} 1 & 0 & | & 2 \\ 0 & 1 & | & -1 \end{bmatrix}$$

Using our secret algorithm, *TALES* transforms matrices into **reduced row echelon form** (**RREF**).

THE FOLLOWING MATRIX IS IN RREF:

$$\begin{bmatrix} 1 & 0 & 2 & 0 & 0 \\ 0 & 1 & 3 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

■ = leading ones
■ = free variables

RREF:
1) Non-zero rows are above zero-only rows.
2) The first entry in a non-zero row must be 1 (called the leading one).
3) The leading one of a row must be to the right of the leading one in the row above.
4) A leading one is the only non-zero entry in a column.

Free variables:
Let R be the RREF of the coefficient matrix of an SLE. If the ith column of R has no leading ones, then x_i is a free variable.

The RREF of an augmented matrix tells you about a solution set.

Matrix: $\begin{bmatrix} 1 & 0 & | & 0 \\ 0 & 0 & | & 1 \end{bmatrix}$

SLE: $\begin{matrix} x_1 = 0 \\ 0 = 1 \end{matrix}$

If there is a row of [0 ... 0 | 1], then the solution set is empty.

If there are no free variables, there is exactly one solution.

Matrix: $\begin{bmatrix} 1 & 0 & | & 2 \\ 0 & 1 & | & -1 \end{bmatrix}$

SLE: $\begin{matrix} x_1 = 2 \\ x_2 = -1 \end{matrix}$

Solution: $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$

Otherwise, the solution set is infinite.

Matrix: $\begin{bmatrix} 1 & 0 & 2 & | & 4 \\ 0 & 1 & 3 & | & 5 \end{bmatrix}$

SLE: $\begin{matrix} x_1 + 2x_3 = 4 \\ x_2 + 3x_3 = 5 \end{matrix}$

x_3 BEING A FREE VARIABLE MEANS THAT IT CAN TAKE ON ANY VALUE, AND THAT x_1 AND x_2 ARE UNIQUELY DECIDED BY IT!

Solution:

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 4-2x_3 \\ 5-3x_3 \\ x_3 \end{bmatrix} = \begin{bmatrix} 4 \\ 5 \\ 0 \end{bmatrix} + x_3 \begin{bmatrix} -2 \\ -3 \\ 1 \end{bmatrix}$$

AND THAT'S *TALES* IN A NUTSHELL!

WHAT DID YOU ALL THINK?

I DUNNO, BIG SIS... ISN'T THIS JUST LINEAR ALGEBRA? IT'S NOTHING NEW...

LET ME GUESS: YOUR "SECRET ALGORITHM" IS REALLY ONLY GAUSS-JORDAN ELIMINATION.

CAN THIS THING PLAY PETZ?

END.

back to the drawing board...

CORAL   VECTORIA   MATHIEU

MEVF

MATHSOC

prof**QUOTES**

CO 351: JOSEPH CHERIYAN

66 It feels like pulling a rabbit out of a hat, but that's how math works.

66 Procrastination is not so good, it helps sometimes, but it's not so good.

CS 146: BRAD LUSHMAN

66 This is 70s technology, and it should've just stayed there.

66 We don't do this for the money of course. We do it for life.

66 What's the other option, you may ask? Running away screaming?

66 The first thing that needs to be said about strings in C is that… C doesn't have strings.

66 *[Referring to strcpy]* No, I would not recommend you to code like this.

66 This is maximum cuteness.

66 There is no withdraw, so I guess my balance can only grow.

66 If you wanna call it cheating, call it cheating. But I call it sticky pages.

66 Never try to be too cute.

66 Oh that's a bigger fix than I intended. I'll leave it as an exercise.

CS 146: ROB HACKMAN

66 The start is just a different form of the end.

66 This is what reality is.

66 Do you like the lies? Too bad.

66 *[Students clap]* You guys are weird.

66 I just really like writing b's… A b is a very satisfying character to write. It just feels good. I also enjoy writing ampersands.

66 Did Brad pay you guys off? The questions are fine, but you guys have so many questions.

66 *[Chooses student]* Don't say the real answer.

66 A tract is like a tract of land. We're not worried about that.

66 Maybe someday we'll get tracts of memory.

66 What are you doing? Aren't we done? *[Students clap]*

66 How much is Brad paying you guys? He denied it yesterday but I'm not so sure.

66 You guys are not talking enough.

66 For module five, we ask you to pull out the breadboards and soldering irons we listed on the course outline.

66 You SHOULD say yay, you should be happy about this, this is cool.

MATH 136: DENE LEPINE

66 So here's an exercise for tonight since we know that all we do on Friday night is math. We're all mathematicians — no one's allowed to have a social life.

MATH 136: SHANE BAUMAN

66 *[Fire alarm on]* I don't have time for a fire alarm!

MATH 148: BLAKE MADILL

66 It's time to let the cat out. Not the real cat, you know.

66 Please raise your heads up for a moment. Oh hi!

66 *[Checking notes on the phone]* I swear I'm not ordering a pizza right now.

66 I can't accept that you like my cat more than me. It hurts my ego.

66 I'm trying to rush because I have -1 minutes.

66 Build a bridge shaped like e^{-x^2}. Who knows what physicists and engineers really do…

66 They're feeding me to the math wolves… I wonder if I can define continuity as being able to draw it without lifting your pencil or something.

PMC PROF TALK: LAURENT MARCOUX

66 If you're captured by the enemy, it's your name, rank, and the definition of a limit.

66 Let's face it, we're in mathematics. If you give me two objects I'm going to start mapping between them right away.

66 What am I doing? Oh my God, what am I doing…

66 This is something we should all be able to recite, even if we're dead drunk.

66 It's possible your basis isn't countable. Life is hard sometimes.

> We have to pay some price for all this nice stuff.

> We're Hilbert space people.

> If people want to leave, feel free. I might do so as well.

N RESPONSES TO MY NEW ROOMMATE COMPLAINING ABOUT LIVING WITH ME

- Beep beep
- show me *where* I give a fuck

- You'd "appreciate me cleaning my room" and I'd "appreciate not living with you" but there are some things in this world we can't change babe
- What the fuck??? Why would you throw out my moldy beans?!! That was for a biology lab!
- That stick is huge. Yeah, the one that's so far up your ass I can see it in your gaping vortex of a mouth when you talk
- No mom, those aren't my used condoms
- Suck my (metaphorical) cock
- Suck my (literal) clit
- Here's a vibrator. Go fuck yourself
- Please understand, from the bottom of my heart: I couldn't care *less* that the apartment smells like ass because of the decapitated head I keep in the fridge and the fact that you keep bringing it up frankly makes you a very unpleasant person
- Hell is filled with people like you
- Go away, meanie
- Bugger off, fucktard
- Hither away, wench
- Never darken my door again, goblin
- You're such a wonderful roommate!

A cool pen name

OLD TUTTE ROAD
TO THE TUNE OF LIL NAS X — OLD TOWN ROAD FT. BILLY RAY CYRUS

Yeah, I'm gonna take my verse to the old Tutte road
I'm gonna write 'til I can't no more
I'm gonna take my verse to the old Tutte road
I'm gonna write 'til I can't no more

I got the pizza in the back
Pizza snacks attached
Crust is carbone black
Got the box that's black to match
Writing up discourse, ha
You can fail your course
I been in The Alley
You ain't been up off dub store, wow

Can't nobody tell me N Things
You can't tell me N Things
Can't nobody tell me N Things
You can't tell me N Things

Writin' like an actor
Got that witty banter
WordPress like my baby
Winning **mathNEWS** Oscar
Editing so groovy
Layin' out these hotkeys
Let 'em go EOT
All you can eat sushi

Can't nobody tell me N Things
You can't tell me N Things
Can't nobody tell me N Things
You can't tell me N Things

Yeah, I'm gonna take my verse to the old Tutte road
I'm gonna write 'til I can't no more
I'm gonna take my verse to the old Tutte road
I'm gonna write 'til I can't no more

Hat down, grad town, looking at my course scars
Spent a lot of money on my brand new Bachelor's
4B's made a habit: senioritis and nostalgia
Ridin' down to Cali in my AI-driven sports car

Got no stress, I've been through all that
I'm feelin' Kafkaesque, the one thing I lack
Wish I could roll on back to that old Tutte road
I wanna write 'til I can't no more

Yeah, I'm gonna take my verse to the old Tutte road
I'm gonna write 'til I can't no more
I'm gonna take my verse to the old Tutte road
I'm gonna write 'til I can't no more

CC feat. girafarig

BEGINNER'S GUIDE TO COMPILE-TIME DESCENT, I

I: COMPILE-TIME VICE

I've been writing these articles for a long time now, and it's dawned on me that I've never actually explained *any* of the big, fundamental ideas related to template metaprogramming in C++. Who am I kidding, trying to write a `std::tuple` clone when nobody even knows what any of it means?

Aha. No excuses anymore. This series of articles is to be a beginner-friendly way of getting you, the reader, up to speed on modern tropes in C++ template metaprogramming. Then, you'll have no choice but to go back and read the entire backlog of C++ template articles! All I ask of you is some experience in the basics of C++. You should probably know what a class is, how construction and destruction works, and some C stuff. The first few weeks of CS 246, basically.

WHAT'S A TEMPLATE?

In C++, *templates* are a facility to let us abstract constants and types out of classes and functions. For example, consider the naive linked list structure from CS 136:

```
struct Node {
  int data;
  Node* next;
};
```

This gives us a linked list of **int**. But what if I want a linked list of **float**? Of Node? Of something else? We'd have to copy and paste this code a million times. We'd go insane. In recognition of this fact, C++ lets you abstract out the type of data by declaring this as a *template* class, with some types to parameterise over:

```
template<typename T> struct Node {
  T data;
  Node* next;
};
```

Now, this basically provides instructions to the compiler on how it can copy and paste our code *for us*, provided we give it some type to substitute in for T. We didn't have to call the parameter "T" by the way; we can call it anything we want, just like naming a variable. Now, if I wanted to construct a list of **int**, I might write this:

```
Node<int> n{5, nullptr};
```

So Node on its own is a template, but inside the angle brackets, we specify a comma-separated list of which types to substitute in for the parameters. In this case, we use T=**int**, and the compiler (say GCC) will see this at compile-time and create a new class type, Node<**int**>, for us, which has everything substituted in, completely concrete. Also note that inside the Node template definition, we didn't say Node<T>* next. That's not a typo; when you're already in the scope of a template, you can just directly use the name of that template and it'll automatically use whatever parameters were given.

We can do this with functions too; for example, doing this, we can write functions that can take an object of *any* type as an argument:

```
template<typename T, typename S>
void fun(T t, S s) {
  ++t;
  ++s.data;
}
// ...
fun<int, Node<int>>(1, Node<int>{5,nullptr});
```

Then, the compiler subs in T=**int**, S=Node<**int**>, and creates code for a function **void** fun(**int** t, Node<**int**> s).

If you look closely at the body of fun, though, you might remark that it only really makes sense if: (a) The type T has some sort of **operator**++ defined on it; (b) The type S is a class type with a member called data; and (c) Whatever type s.data is needs to also have some sort of **operator**++ defined on it. And you'd be right! In fact, if you tried substituting types into the parameters and one of those conditions wasn't satisfied, then the compiler would yell at you and refuse to compile your stupid ill-formed nonsense. All too common, hm?

Something worth knowing is that if your template type parameters for a function only come from its arguments, then it isn't necessary to explicitly give the type names in the angle brackets. Above, we could've just done fun(**1**, Node<**int**>{**5,nullptr**}) and the compiler would've correctly deduced T=**int** and S=Node<**int**> for us, automatically.

One last thing is that, in addition to types, you can parameterise over sufficiently "simple" objects. For example:

```
template<int N> struct Integer {
  const int num = N;
};
// ...
Integer<5> n; // n.num is initialised to 5
```

Something important to also note is that all of this template substitution stuff happens **at compile-time**. That is, the compiler has to be able to figure out and "expand" all of this stuff during the compilation process, before the program is ever run. Consequently, the type parameters we provide have to be known/resolvable at compile-time, and the non-type template parameters we give have to be *constant expressions.*

WHAT'S A CONSTANT EXPRESSION?

A constant expression is any expression which can be completely evaluated during the compilation process, without ever running the program. For example:

```
struct Thing { /* implementation */ };
// ...
int x = 5;
  // x is NOT a constant expression, but 5 is
Thing t{ /* args... */ };
  // t is NOT a constant expression
const Thing s{ /* args... */ };
  // s MIGHT be constant expression
constexpr Thing u{ /* args... */ };
  // u IS a constant expression, assuming
  // Thing has a constexpr constructor
```

The first ones, x and t were probably obvious. But s is weirder, and u has some syntax that you might not have seen before! We won't worry too much about the scenarios in which s is a constant expression; it's mostly up to some technical conditions, and it's not all that important since we won't generally be using const that much. On the other hand, we *will* be using **constexpr** a *lot.* Basically, the constexpr specifier is your very own way of promising to the compiler that the variable or function you're about to declare can be evaluated at compile-time. So, something like **constexpr int x = 5;** would declare x to be a constant expression. Variables that are **constexpr** have to be initialised at declaration, and are immutable. These make sense as basic requirements for something to be evaluable at compile-time, right?

Now, the reason I qualified the bit about u is because, if I want to declare a **constexpr** Thing, then we must be able to construct a Thing at compile-time. Specifically, the constructor we invoke for that Thing must be declared as **constexpr**. This comes with the set of restrictions you might imagine for a function whose value is evaluable at compile-time:

- The function (or constructor) can only invoke other **constexpr** functions.
- The function body can't declare any non-**constexpr** variables.
- The function (or constructor) will only actually be evaluated as a constant expression if all of the given arguments are also constant expressions. Otherwise, an invocation of the function won't be a constant expression.
- It can't be **virtual**. So, no polymorphism.

There are a few other tiny things, but those are the real important things to remember. Keep in mind that we're concerned about *expressions,* not objects or values. The expression is just the letter "x", not the actual object which it represents. Generally, all literals are constant expressions.

So, that's templates. Seems pretty useful, and mostly simple (if not a little rough around the edges syntactically). The constant expression stuff is also cool I guess, albeit a little dry and technical.

Well, it ain't Turing complete for nothing. So begins our descent.

jeff

THE IMPOSTER SYNDROME IN COOP SEARCH
IMPOSTER SYNDROME GO BRRRRRRRRRRRRR

I'm writing this on the last night of the first cycle posting as a co-op student. The imposter syndrome is real and it kicks in hard, seeing all the requirements and jobs that you are 100% not suitable for but apply to anyway. The languages they need sound like someone was too drunk to type a coherent word or name and ended up mashing a random letter combination to add an extra requirement just to mess with you. You are just hit with despair and anxiety as you try and sort through every posting that there is. I can assure you that you are not the first and will not be the last to feel this. This is an ancient UWaterloo tradition that we maintain across the generations, that dreaded co-op search. *shudders*

As someone in the same position as you, I cannot offer much advice to help secure the co-op. I, however, can offer the following things that I have picked up from people all over the faculty. You are not the only person in this position; you just don't notice it. I can guarantee that everyone whom you think is doing just fine is reeeeeing with you over impossible co-op choices right now. I know I have launched more swear words and verbal assaults over WW than is humanely possible in an $\epsilon > 0$ period of time.

With that information, try to not lose your sanity and go full Kermit-jumping-off-the-roof mode. You are still allowed to snort some coke to relieve stress (Kermit endorsed) but be aware of legal limits on such activities.

Wishing you all the best on a cursed hunt, and hopefully you will join kermit (if I find a job) in doing some "fun activities" after work next term! ;)

KERMIT

FIGHTING THE INVISIBLE ARMY
THE NEW CYBER WARFARE ISN'T FOUGHT OVER STATE SECRETS; IT'S FOUGHT OVER YOU.

The internet occupies an ever-growing psychological space within each of our minds. It allows us to communicate and access each other in ways previously unimaginable. With these abilities also comes great opportunities for new modes of warfare, for indeed, the newest form of warfare is not immediately fought over land, oil or any other resource: it is fought over the minds of the public.

Cyber warfare is real warfare, because the ability to accurately inform oneself is the foundation of a healthy democracy. The most current and threatening form of hybrid warfare aims not simply to gain government secrets, but to weaken democracy itself by using fake news and informational fallacies to warp our perception of what is real, and what should be. It changes our perception of how to act.

The mechanisms by which we are attacked are ingeniously integrated into the very systems we rely on for freedom of speech, contextually obscuring the meaning of information, unnaturally amplifying it systemically, and skewing our perception of reality. These tactics threaten to obscure our ability to communicate and turn us against each other by subtly changing the meaning of the information we see.

The way we perceive information is highly dependent on the context in which it is situated. By **hiding** or even selectively **recreating** the **context** of a given piece of **information**, its meaning can be entirely **manipulated**, allowing its viewers to become more susceptible to its *intended effect*.

An analogy from the tech industry is most helpful for illustrating this.

Most people have caught on to the fact that behavioural advertising systems will target them with advertisements depending on what they search or say online. What is less obvious, however, is that for every advertisement that you see, thousands remain hidden from your view because you weren't targeted for them. Some may be good, and some may be bad. Whatever they are, you didn't see them. While advertising networks use algorithms to feed information to their viewers, contextual obscuring of news usually takes the form of leaked or little-known information from a reporter, thus sparking controversy and debate. While the information may itself be relevant, there is usually a reason *why* you are seeing it. What would someone want you to feel? Why would they want you to feel that way? Perhaps if we knew more, it wouldn't seem so condemning or exonerating for those involved. This tactic becomes important when the context of a given piece of information remains hidden, inherently changing its significance and meaning. The information itself becomes unnaturally and purposefully selected against its contextual counterparts to evoke a particular reaction in its viewers.

Here's another perspective with troubling consequences.

Political philosopher John Stuart Mill once said that power over the state always lies in the hands of the public because of their overwhelming collective strength. This power, however, relies on the ability of the people to communicate with one another. Social media platforms in particular have revolutionized this ability, and we increasingly rely upon them for social contact and essential messaging. I believe this is troubling because of the ease with which communication can be manipulated on these platforms. With nothing but a few lines of code, user's emotions and beliefs are subject to the whim of one or more algorithms designed to tailor the content displayed to us.

A study done at Facebook and Cornell University showed this very effect in action, as the contents of nearly seven hundred thousand people's news feeds were manipulated to produce corresponding emotional responses.

The emotional contents of their news feeds "rubbed off" and the posts of the users responded very strongly in emotional content. The users became positively or negatively affected by the manipulated emotions displayed in their news feeds.

The mechanism by which this effect was achieved, was one of contextual obscuring.

The systems that we rely upon for communication are also misused in other ways. Artificial intelligence algorithms have become increasingly good at replicating human speech patterns, and what originally started as a computer network tool has turned into a social media epidemic of misinformation and gaslighting. Bot social media accounts seize upon fake news articles and stories become unnaturally spread at an alarming rate. I use the word unnatural, because these accounts are not the thoughts and feelings of the rightful citizens they pose to be, but rather the machinations of an algorithm. This in essence, is **unnatural systemic amplification**. While the so-called "power law" of social media still holds, this behaviour adds an additional layer to the spreading of misinformation, increasing the chances of weakening a person's susceptibility to fake news and expanding the reach of a single article.

These strategies, therefore, are a brilliant method of covertly destroying democracies from the inside out.

While tools such as AI powered fake news detectors and initiatives led by tech companies are slowly advancing, our own politicians fight against an invisible army. We need to sound the alarm and fight back, and I believe the answer is education.

Education does not limit freedom of speech. Education does not remove our human rights. True education does not indoctrinate or bias. Rather, I believe that to educate is to emancipate, for learning how to think critically can only be a tool for self empowerment.

Just as immunity will protect you from a virus, so too does education protect from the infection of fake news. If we are drowning in a tide of misinformation, education will teach us to swim. The warfare that was once fought over the minds of the public will come to an end. All that remains is to ardently participate in our precious democracy.

Ultrabyte

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LIST OF MY FAVOURITE WORDS

WORD

1. The
2. It
3. Of
4. And
5. Little
6. Big
7. Please
8. Thank
9. You
10. Me
11. Around
12. Then
13. Moreover
14. Ground
15. Up
16. Lit
17. Nice
18. Hot
19. Shirt
20. Orange
21. Word

gittle

N THINGS TO DO WITH YOUR LIFE THAT DON'T HAVE TO DO WITH SCHOOL AND WORK AND SOCIETY

- Go for a walk! Waterloo has some great trails and regional forests you can explore, and summer is a great time to do that.[1]
- Start a diary! It can be immensely therapeutic to have an outlet for your thoughts. Even if you don't think you need it, give it a shot and you might start to love it. Alternatively, if a diary seems too high-commitment and not public enough, make a Twitter account[2] and engage in subtweeting[3] and vagueposting.[4]
- Clean your room! Okay, this feels distinctly not-fun, so I'm going to add a tip here; clean your room *while listening to and dancing along to music.* It's so fun, you have all the pleasure of dancing and none of the fear of people watching. You have actions you can naturally take while cleaning your room that you can do to the beat, making dancing easy even if you don't think you can dance like me.
- Reinstall your operating system! It's like cleaning your room but for your computer. You get rid of all the old cruft, back up the things you need, and then just hose everything right off and start from scratch. It's a glorious feeling.
- Play video games! Some would argue that video games are a waste of time, but I would say that if God didn't want me to play video games, He would not have created them. Note that if you want to not involve society as mentioned in the title, you should restrict yourself to playing single-player games only — I would suggest the Phoenix Wright: Ace Attorney series, Stardew Valley, and Undertale as starting points, if you haven't yet played any of those.

tendstofortytwo

1. https://www.regionofwaterloo.ca/en/exploring-the-region/forests-and-trails.aspx
2. Note that a Twitter account may be considered by some as having to do with society.
3. https://dictionary.cambridge.org/us/dictionary/english/subtweeting
4. https://www.urbandictionary.com/define.php?term=vagueposting

You know, I've been told we live in a society.

A GAMER EDITOR

OPEN THE MATH C&D

So I waltzed onto campus, September of last year, for the first time in years, as many of us did. And when I left my first lecture of the term, in that hallowed building known as Math and Computer, I felt a little hankering — a little worm, a little squirm in my stomach. It was noontime and I hadn't eaten breakfast (twas that noxious potion of morning classes and sleeping schedule woes, as we are all familiar with). That feeling I felt — it was hunger.

At that moment, there was only one thing I could think to do. One thing I *knew* to do. To go to the little store up on the third floor, where sweet pastries and warm sandwiches, samosas, hot coffee, every delectable item a wandering student could really need, would be sold at an affordable price — of course, no WatCard, but that's of no worry to a senior student like me, far beyond meal plan years, and besides, no one minded, the convenience of the place was too hard to beat. That little shop, so sparing in square footage, where you had to throw your humble rucksack into a little cubbyhole at the front entrance — to follow the 'no bag' policy, it was a place of respect — although in the busy times you would more likely have to set your bag gingerly on the floor, such was the popularity and reputation of the place as the mathematics watering hole; the assembly-line queue that squeezed you through the two (2) aisles, slowly but uncompromisingly (heaven help you if you decided to get a French Vanilla *after* you had spooned yourself some chili). Did I mention that samosas were only $1.60? You may know what I'm speaking about. No other establishment on campus, nay, on Earth, befits such description.

I climbed the stairs. The doors were locked. The inside, dark. My confusion, immeasurable. In uncertain chalk, I saw, on the blackboard outside the C&D:

Due to renovations, it would reopen in the winter term.

Winter term? Certainly, I felt a crushing disappointment that the great return to on-campus life would lack one of its great centrepieces. When the watering hole dries up, where do the animals go? But I could wait. I could have grace. I could be patient.

October, November, December came and went like blinks of an eye. At home for the holidays, as the year 2022 dawned near, I held fast to the promise of the return of that cherished oasis.

Upon my return the next term, I rushed to the third floor again, with much mirthful excitement. Alas, my expectations were dashed — before me once more were those baleful closed doors and that dreadful black, cold interior, wholly devoid of the lively radio tunes and young chatter which had been the soul of this brutal cage. I wanted to cry out, but my throat would not make a sound. In disbelief, my wide eyes fell to the blackboard — the message was one and the same with the one from four months past, but the estimated opening time had been erased and rewritten with not even a gasping attempt at surreption. Where used to read "January" was now written "June."

The passage of time marched on. It is now May. May 2022. The renovations for that woefully missed place are nowhere near close to done. Word has spread that they'll be needing to update that lonely chalkboard once more to say "September." *September 2022.* It will be a whole year of this. A whole year of waiting. I will weep and gnash my teeth all the while, but it will come to nothing. My love for that place means nothing. The C&D opens when it opens. Hope and love and sentimentality is nothing, a grim lesson that I've come to learn. So thanks for everything. Welcome, sorrow. Welcome, despair!

Finchey

N REASONS WHY I DON'T LIKE R

1. R is bad.
2. It's ugly.
3. Unhelpful with errors.
4. There exist better, more developed languages (MATLAB, Python) that can do what R can.
5. I would rather do stats by hand than with R.
6. For ML and math I'd rather code in MATLAB — the university offers a free license, so why not do that?
7. I don't like it (I will not hear anyone out).

the rock

EXPLAINING MATH RESEARCH TO MY PARENTS: WEEK 1 OF 6

AND HOPEFULLY RECRUITING SOME NEW ALGEBRAISTS ALONG THE WAY

This summer, I'm lucky enough to get paid to do math research. It really is a dream job — I get paid to *think* all day. The hours are flexible, I can work literally anywhere, and the work is rewarding. The only problem is when people ask me what I do, I have *no fucking clue* how to answer. I can either give a 25 minute lecture or mumble something about noncommutative algebra — explaining my research problem succinctly is nearly impossible. However, my parents are wonderful and supportive, and would like to learn about my research. Enter these articles! For the next 6 issues of **mathNEWS**, I'll be explaining all the necessary background to understand the research problem I'm looking to answer, as well as enough background to understand why the problem is interesting. Before that though, I wanna talk a little bit about what doing math research looks like for me.

When I had my first meeting with my supervisor, he sat down and told me something to the effect "You can choose one of two problems. One of them is a disgusting computability thing with Turing Machines. The other one is an algebra problem". Now I do not know what a Turing Machine is, so I took the algebra problem. He then defined some relevant terms, and stated the problem. For those of you who know an insane amount of math here it is.

Let R be a $k-$algebra, σ be a frame preserving automorphism of R. If R has bounded matrix images, does $R[x; \sigma, \delta]$?

Now to almost everyone, this is probably gibberish — and the goal of these articles is to teach you to understand it. What really matters is that it's a statement of the form "Does every [thing] have [property]". In math, it doesn't just suffice to produce a ton of examples, we need to provide a proof — a mathematically precise, logical argument explaining why it always holds. However, this is a problem that nobody has ever solved — so there's a question of whether or not it's even true. Back in first year, when I first heard about people doing this, it felt impossible to me. I mean, if I spend time trying to prove a statement that turns out to be false, it'll be futile, and if I look for counterexamples to a true statement, I obviously won't get anywhere.

Luckily, you can get lots of places without knowing if it's true or false. The question "Does [thing] always have [property]" was asked because my supervisor ran into *lots* of [things] that had the [property], and so he made a guess that it always holds. Even if it doesn't always hold, it does hold sometimes, and asking the question of *when* it holds is incredibly interesting. I started the question by proving some specific examples of [thing] had [property], then checked what facts about [thing] I was using. This allowed me to generalize a little — prove it for a whole set of examples at once. It was an incredibly narrow set, and I'm sure it was already known, but it got me thinking at the problem. I then looked at the core ideas of that proof, and tried to prove a slightly more general

case that related to those ideas, and so on. I pieced together little cases where it had to be true, and simultaneously, I worked on classifying a new set of useful examples, so I could work with them.

This is helpful for a couple reasons — even if the conjecture turns out to be false, knowing when it's true tells me where I *shouldn't* look for a counterexample. These special cases might also hint at the general proof — maybe the problem can be reduced to a special case, or can be proven by handling a few special cases that together cover every possibility. What I'm doing gives me insight into the problem, and it's a useful step towards either a proof or a disproof. I don't know what math research is like in general, but this is what it's been like for me so far, and I've gotta say, I love it.

With that out of the way, let's start with some very barebones mathematical content. A *set* is just a collection of things. I know this is imprecise, but formalizing it is so much more trouble than it's worth. If I want to talk about the collection of things with the letters a, b, and c, I would denote this by $\{a, b, c\}$. Sets can contain anything — numbers, letters, houses, other sets — but we'll always denote it by putting curly braces around the things in the set. A set by itself is pretty boring though (sorry set theorists!) In math, we like interaction, not just a pretty collection of things sitting there. *Functions* are the most basic form of this. A function f is simply something that takes in elements of one set, and spits out elements of another set. If f takes elements of A and spits out elements of B, we would write $f : A \to B$, which reads "f is a function from A to B".

Now, we also like when our sets have some kind of extra structure. This is perhaps easier to understand with an example — the integers (all the positive and negative whole numbers, the set $\{..., -2, -1, 0, 1, 2, ...\}$; we'll denote it $\mathbb{Z}$ for short.) are interesting not just because they're the numbers, but because we can add and subtract and multiply them. When we add the extra structure of addition and subtraction and multiplication we can ask about solving equations and prime numbers and all the lovely interesting questions we can learn about the integers.

Sets which have some notion of addition and multiplication are called *rings*. We can add and multiply lots of things; whole numbers, fractions, real numbers, imaginary numbers, and next week, we'll see a cool new example called *matrices*. We can add and multiply functions, so long as we can add and multiply the outputs, and if you know any modular arithmetic, the integers modulo n give us another example.

For those of you who know matrix multiplication or addition modulo n, they might feel quite different from other addition. This raises a valid question — what do we mean by an addition or multiplication operation? What we really mean is an

operation "+" that takes in two elements of our ring and spits one other element out, that obeys some obvious properties

- $a + b = b + a$ for every a, b
- $(a + b) + c = a + (b + c)$ for every a, b, c
- There is some element we'll call "0" so that $0 + a = a$ for every a
- For every a, there is an element b so that $a + b = 0$; we'll usually denote this b by $-a$

And for multiplication, similarly an operation "$*$" which obeys some obvious properties.

- $a * (b * c) = a * (b * c)$
- There exists a 1 so that $a * 1 = 1 * a = a$ for every a
- $a * (b + c) = a * b + a * c$
- $(a + b) * c = a * c + b * c$

You may note that the condition $a * b = b * a$ is not present, and this is since we don't require it in a ring! If a ring has the property $a * b = b * a$, we call it a commutative ring, and these are widely studied. Next week, we'll talk about why we might care about multiplication that doesn't count, and give a more interesting example of rings. See you then!

*gild*ED

N REASONS WHY 1 IS NOT EQUAL TO 1

- In different fonts, 1 is written differently, so this means that they must not be the same, so $1 \neq 1$.
- If $1 = 1$, then $i^4 = 1$. But the 4th issue of **mathNEWS** is not equal to 1, that makes no sense.
- My one piece of cake is not equal to your one piece of cake.
- If $1 = 1$, then $1 - 1 = 0$. But $1 - 1$ looks like the letter ",H, and not the letter "O," so $1 \neq 1$.
- If $1 = 1$, then that would mean mathematics is founded on a true statement. But everyone knows math is not real, so it must be false.
- Because if you disagree with me, I will personally tell you that you are wrong.
- My dad works for mathematics, and if you try and tell me I'm wrong, I will have you banned.

That last point is very true, source: dude just trust me.

Wink wonk

AT WHAT AGE

Do people start waiting for you to die?

X-student

OVERWATCH 2 (2LATE OR 2SOON?)

If you're an epic gamurr, chances are you've heard the news about *Overwatch 2*. Finally, some good food. *Overwatch* delivered 4 new maps, 1 new playable character, one new mode and… that's it. The new maps (2 for the new mode, 2 for existing modes) brought Toronto, Monaco, New York and Rome into the year of 2077, with the funniest image of the TTC that I shall link below.

OVERWATCH 2 **SHOWS TORONTO LIKE YOU'VE NEVER SEEN IT BEFORE—WITH A FUNCTIONAL TRANSIT SYSTEM**

For the record, this includes a circle line connecting St. Andrew, Queen, York University, Osgoode and Leslie. You'd think we'd be happy, and for the first week, yeah! Except things kind of got stale. There's a bunch of changes to the meta now that there's been a shift to 5v5 vs. 6v6 that original *Overwatch* had, but some heroes excelled and others… did not. Tanks are different now, there's two who received reworks and major changes and in general, most of the DPS. Healers, on the other hand? Well, they got a passive of self-healing, but that's it. Healers are pretty easy targets to dive in the game already. Not to mention, the role queue is 1 tank, 2 dps, and 2 healers—so DPS can easily flank and eliminate a healer. Fights are incredibly fast-paced and scrappy, much more than the original.

The problem, though, lies therein that only one new hero was released (Sojourn, a DPS), after two years of little content. The last hero was released in April of 2020, just as the pandemic started, and was also a DPS. Supports and Tanks are hard stuck for new content. Sure, every hero feels a little more different to play, but there wasn't really a lot of hero content. *Overwatch 2* is the sequel, yes, and it's only a beta, but it doesn't really change much other than the fact that we're sort of overdue for a new support, or tank. There's content, but there's only so much we can do. We don't even have a roadmap! All we got over two years was a few short stories, but some of them feel questionable, and one outright derailed someone's characterization (unless some form of brainwashing was involved). It's great, and I understand the team is trying, but also. We're kind of being left high and dry here after that. Give us a little clue in on what—or who—is next?

Skit

BASEMENT OF MC

(sing to Paradise City by Guns N' Roses)

Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Oh won't you please take me home?
Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Oh won't you please take me home?

Just a student living under DC, I'm a
Dean's Lister who is tough to beat
I'm your studying mate so quiz me on the course please
I'll get almost all of it right, time to study this one more time

Make side projects or so they say, you gotta
Keep pushing for the Cali 4A, you know it's
It's all just Leetcode at the end of the day
You treat it like it's not worth a dime
Everybody's doing their grind

Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Oh won't you please take me home? Yeah-yeah
Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Take me home

Sitting on a table in the PAC gym hall
All I learned this term, it is time to recall
The exam proctor says it's now okay to start
I'd have another revision but it's too late
Whatever happens is fate

Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Take me home, yeah-yeah
Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Oh won't you please take me home? Yeah

Thank Miiiiiister Goose [x4]

Prez Feridun's been gone a while, now
Vivek is here and he's leading with style, he says
We're "inspiring innovations with global impact"[1]
I think we're all on the track, in fact, to sign with geese
another blood pact

Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Take me home, yeah-yeah
Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Oh won't you please take me home?
Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Take me home, yeah-yeah
Take me down to the basement of MC

Where the profs all teach and the rooms are dingy
Oh won't you please take me home? Home?

I wanna LEARN, I wanna Quest
Oh won't you please take me home?
I wanna see how bad it can be
Oh won't you please take me home?

Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
(Take me home) Oh won't you please take me home?
Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Oh won't you please take me home?

Take me down (oh yeah), take me down
Oh won't you please take me home?
I wanna see how bad it can be
Oh won't you please take me home?
I wanna see how bad it can be
Oh, oh take me home?

Take me down to the basement of MC
Where the profs all teach and the rooms are dingy
Oh won't you please take me home?
I wanna LEARN, I wanna Quest
Oh won't you please take me home?

tendstofortytwo

1. https://uwaterloo.ca/president/

WHY THE SPRING TERM IS THE BEST

1. there is no reading week, but we have Victoria Day weekend
2. the baby geese are terrorizing the campus being mentored by their parents
3. the rooms in MC become a sauna and I'm able to smell everyone's body odour
4. bus times: next bus at 20 minutes, 50 minutes, 1029424 minutes
5. half of my courses are online??? (thank you arts faculty)

All jokes aside, I'm a bitter student in sequence 4 who has to do three school terms in a row. However, seeing the beautiful trees around campus and sweating in MC is a dream come true.

panda

WELCOME BACK

I watched, as I sat by the gate in the airport terminal, the last bits of sunlight. Thank goodness it wasn't a super rainy day. I hadn't expected to be brought to tears from this moment, and yet there was a sudden realization that somehow made it so. Perhaps I shouldn't have booked my flight to leave so late at night, but with how everything had to line up just right for move-in day, I really had no other choice. The take-off at night had an additional impact, it would soon turn out.

Remembering the CGP Grey video of packing monkeys into a plane soon came and went as the sold-out flight began to settle in. To my right was the window, and to my left the flight attendant was presenting the standard pre-flight safety information. As the plane began taxiing down to the runway, the lights were dimmed down and it would remain that way overnight. I always found planes too loud to be able to sleep in, and I'm astonished by those who are actually able to fall asleep.

As the plane took off, I looked through the window and saw more and more of the city becoming visible, smaller, distant. Every road a series of dotted lights, vast swathes of the nightscape a testament to light pollution, and every feature feeling so familiar like it was on a map, that I realized that it would be the last I see of them for quite some time. That was when the tears could not be held back any longer. Despite knowing that identifying more places kept the tears coming, I somehow could not figure out how to turn my head away from the window. Who knew that being able to identify key highways and natural features of the region from an aerial view could be such an emotional thing?

I tried to not make a fool of myself, so I think that was some of the most silent crying I have ever done, although I do acknowledge the help of the loud plane and dimmed lights from preventing me from bothering those around me. Looking back, I can only wonder, how did this moment end up turning out to be the most emotional part of my journey that day? Not even saying goodbye to my family at the airport came close to this.

Once the features out the window became less familiar and more 'light pollution of unknown origin', I calmed back down and began my ritual of every flight, which is to watch the movie "Charlie and the Chocolate Factory". I don't know how watching that movie every flight became a thing, but at this point it has become a personal tradition.

The rest of the trip was basically uneventful. The plane landed just fine, and the drive from the airport was prevented from becoming a bore thanks to being able to strike an interesting conversation with the driver the entire way there.

As I saw the highway sign saying "Kitchener", as I saw another saying "University Ave.", and as Laurier passed by, a final striking thought appeared in my head: "Welcome back to Hell." The real trial would start now.

It has been quite a while, hasn't it? Let's see how it goes this time around.

boldblazer

VIL 101 (INTRODUCTION TO VILLAINY)

Do you ever feel a seething, unending rage against the world, and all beings who dwell in it? Have you ever felt like the universe would be a better place if it was rebuilt in your twisted image? Have you ever wanted to use an elaborate scheme to solve a mildly annoying problem? Then villainy is for you!

In addition to helping with the aforementioned issues, being a villain gives you a lot of advantages over the average citizen. Depending on the type of villain you choose to be, you'll enjoy not being bounded by the laws of the land and/or the laws of physics. And the lack of a conventional moral code opens up a lot of career options for an aspiring baddie.

This course covers basic villainy that's applicable to all types of villains. Gaining great amounts of power, going against established rules to use that power in the most effective way possible, and finding weaknesses of those who try to stop you. It is also a prerequisite for VIL 102 (Deconstruction of ethics), VIL 223 (Taking advantage of political turmoil), and VIL 257 (Mechs, lasers, and more!).

If you're still not convinced, here are some reviews:

- "I got multiple lawsuits because of this course, but they can't collect if they can't find me!"
- "If you're evil, or even if you're morally grey and considering evil, this course is a must-take."
- "The prof was engaging, yet mortally terrifying."
- "The content was way too difficult. Which gave me the tragic backstory I needed to become truly evil!"
- "⅗"
- "Thanks to this course, I was able to start putting my villainy skills to practical use. I can't say what I did, but trust me, it was bad."
- "This course changed my life for the better, and others' lives for the worse!"

*some*BODY

QUICHENEWS: AN EGGY ADVENTURE

Yesterday, my partner (read in an old Western accent) and I made 2 quiches. A quiche, NOT pronounced "quickie," is a delicious egg pie that is typically loaded with cheese and vegetables and/or meat. Super tasty, but also surprisingly high in calories, meaning it absolutely obliterated my Hot Girl Summer diet.

Anyway, this quiche was a loaded vegetable quiche, since I wanted to make it vegetarian-friendly for a friend of mine. Definitely not vegan-friendly (the main ingredient is egg, the pie crust was made using lard), and the pies had enough cheese to make lactose-intolerant people shit themselves out of existence.

It turned out super good! So I thought I'd share this core memory with y'all. And since this is **mathNEWS**, I'll give a price breakdown.

Price of 2 homemade quiches:

- 300g old cheddar cheese (1.3 kg/$13.99 at Costco): $3.22846153846
- 2 deep dish pie crusts (1 box/$4.79 at Zehrs, yeah I gave up and didn't make the crust from scratch like I usually would, wanna fight?): $4.79
- ½ lbs zucchini (1 lb/$1.49 at T&T): $0.745
- ¼ lbs mushrooms (0.5 lbs/$2.99 at T&T): $1.495
- 2 roma tomatoes, approx. 370g total (1 lb/$1.99 at T&T): $1.6218061674
- 2 tbsp olive oil (negligible, but I'll make up something): $0.30
- 4 tsp dried basil (negligible, but I'll make up something): $0.23
- 4 tbsp flour (negligible, but I'll make up something): $0.11
- 6 eggs (12 eggs/$3.59 at Zehrs): $1.795
- 250 mL milk (2 L/$4.89 at Zehrs): $0.61125
- salt (negligible, but I'll make up something): $0.06
- pepper (negligible, but I'll make up something): $0.06

Total: $15.05 for 2 pies, lasting about 6 meals. Whatta steal!? Idk I haven't seen quiche on a menu in a long time. I think I might've ordered it in an overpriced hipster board game cafe and one slice of cold quiche with a side of salad was $16 including tip.

Of course, the secret ingredient is time, effort and love, which despite my UW math skills, I cannot calculate the price of! ^_^

yummyPi

OUTSIDE OUR SIGHT

You ever think about how much invisible stuff is all around you all the time? Because there's a ton.

Just take radio, for example. All the radio waves are constantly bouncing all around the world, transmitted out from their source, looking for a receiver to pick up on the message and turn it into sound. All these sounds, all these messages, all at every frequency along the radio spectrum. And that's only part of the electromagnetic spectrum.

There are all those little photons bouncing around, carrying light from place to place, and holding the colour that our eyes end up translating. They're all around us, bouncing around, being absorbed and reflected by every object around us, and only some of them end up in our eyes, filtered and parsed. Moving at the speed of light by definition, and never stopping.

It's incredible to imagine, and it's even all the same stuff as the radio waves, just on a wider spectrum. Photons build up so much of our experience of the world, and they're moving all around. In Earth, and all through space, too, constantly relaying information from place to place.

We are swimming amidst data.

On a much larger scale than that, of course, are all the air particles bouncing around, filling up a room, jostling each other for space, pushed by gravity towards the Earth's core, bouncing into your skin and bouncing back, getting sucked into your lungs, and more always being created through photosynthesis. We would be drowning in them, except they're what let us breathe in the first place. As you get closer to space, there are just so many fewer and fewer until eventually, you reach the very top of the atmosphere, and there are only a few stray particles remaining, floating around, having lost out on the race to the bottom against all their siblings.

And there are all the bacteria living within us, swimming between our cells, having no knowledge that they will spend their entire existence within giants. And yet, we could not survive without them, and they could not survive without us. In fact, they outnumber the cells of our own body. We're more other creatures than we are us, which almost sounds laughably false at first. But it's all true.

My only real point to this article is to point out how cool life is on the microscopic level. Hopefully you think this is cool too, or at least worth however long it took you to read. We can tend to get lost amid the incredible scale of the cosmos, but we should remember that we have our own incredible scale, too.

Predap

A FUN 2022 ONTARIO ELECTION CHOOSE YOUR OWN ADVENTURE

1. who do you plan on voting for?
    a. conservatives–go to 2
    b. greens–go to 9
    c. liberals–go to 12
    d. NDP–go to 14
    e. Other–go to 3
2. why
    a. kathleen wynne–go to 4
    b. taxes–go to 5
    c. owning the libs–go to 15
3. what colour is the party's material?
    a. blue–go to 6
    b. red–go to 8
    c. other–go to 7
4. I, too, wish I could be living in 2015.
5. something something we're to the left of the optimal place on the Laffer curve
6. seems kinda sus but okay
7. well, you're voting for the party you believe in, I guess. Best of luck to you.
8. see 7, but also communism.
9. do you live in Guelph?
    a. Yes–go to 10
    b. No–go to 11
10. reasonable choice
11. cope
    a. cope –go to 18
12. are you under 40?
    a. yes–go to 17
    b. no–go to 13
13. go figure.
14. do you live in the 905?
    a. yes–go to 16
    b. no–go to 22
15. please develop a personality that isn't Ben Shapiro and try again
16. why
    a. what?–go to 20
    b. suburbs–go to 19
17. why
    a. because I like them– go to 19
    b. better red than blue–go to 23
18. continue coping until the next election – surely the Greens will sweep!
19. yeah you should vote libs
20. nevermind. Do you think that splitting the non-conservative vote is a problem?
    a. yes–go to 21
    b. no–go to 22
21. cope, then vote liberal
22. go nuts, vote ndp then
23. we live in a society (derogative)

But no matter who you plan on voting for, you should still vote. Go to `elections.on.ca/waystovote` to find out how/where you can vote.

lemontea23

1ST YEAR CS COURSE HELPS YOU WITH CO-OP(?)

Let us review my first two semesters as a CS student at Waterloo. I have no previous programming experience, and I came into CS blind. CS 145 covers Functional Programming (Racket), and CS 146 covers Data Abstraction and Algorithm Design (in simpler terms, interpreters, interpreters, interpreters, and C).

I was quite nervous at the idea of co-op, and guess what happened: I opened the co-op portal, glanced through some job requirements; Javascript, Java, HTML, SQL, …

"What"—that's too many requirements for a first year, I think? CS 146 and CS 145 are already time consuming as-is, and I don't have any time to do extra stuff. The only time I have to do extra stuff is between semesters, which barely adds up to 2 weeks, which I spent learning Python and C.

Waterloo's CS curriculum is pretty different—in fact, it's pretty famous in that regard. But it's actually pretty surprising how different things would be between a job requirement and the skills we are taught in the first two years of CS.

In short, don't be like me :D

viverson

TEST ARTICLE PLEASE IGNORE

SPHINX OF BLACK QUARTZ JUDGE MY VOW

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam quis libero non ipsum malesuada aliquet nec id urna. Praesent vitae tortor convallis libero tempor blandit non eget magna. Donec scelerisque est at molestie rutrum. Sed aliquet metus vel eros accumsan, id tempus velit blandit. Maecenas vitae tortor lobortis, auctor lacus sed, fringilla dui. Duis turpis lorem, sollicitudin ac sagittis nec, volutpat dignissim tortor. I would like for you to notice the gorilla. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed libero lectus, condimentum eget diam in, tincidunt vehicula velit. Fusce accumsan at turpis in ornare. Etiam volutpat suscipit faucibus. In lectus elit, gravida eu tortor ut, euismod aliquet sapien. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia curae; Phasellus tempor eleifend nisl, vitae condimentum sapien convallis eget.

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Xx_420SonicFan69_xX

1. Find it.
2. Find it.
3. Find it.

TONY'S TECH CORNER

Hello, and welcome to the second instalment of Tony's [insert cool name here] after a 3 year break…

This week, I want to mention how to use graphics tablets on Linux (with X11) if you have multiple monitors. (We'll touch on Wayland another week).

By default, connecting a graphic tablet such as a Wacom will map the full resolution of the X11 window to the tablet. If you have more then one display, it will mess with the aspect ratio.

The solution is simple. If you are on X11, this can be done with xinput. You can also use xsetwacom with libinput.

First, check the list of input devices by doing:

```
xinput
```

This will return the list of input devices. You want to search for the one that is the pen or stylus for your tablet, as it is the one that send the mouse inputs. Copy the ID of this device.

Since most devices have the word stylus, you can just grep for it:

```
xinput list | grep "stylus"
```

Then, check the display name you want to map it to by running:

```
xrandr
```

or using a display manager of your choice.

Finally, to map the input to the display, run the following:

```
xinput map-to-output <input> <display>
```

For example, to map input device 10 to display DVI-D-0:

```
xinput map-to-output 10 DVI-D-0
```

Alternatively, on some systems, you can use xsetwacom to achieve the same thing if you don't use libinput:

```
xsetwacom set 10 MapToOutput DVI-D-0
```

Tony

I MISS YOU

That's all.

Absolutely smitten

UKNIGHTED AND THE SLOW TAKEOVER OF mathNEWS BY THE ENVIRONMENT FACULTY

As you all know, there's two new editors—gildED and uknightED. I am uknightED, and I'd like to first preface that ED for me doesn't stand for EDitor. It stands for Environment Domination.

That's right. This is all a ploy to slowly take over **mathNEWS** until everyone is part of the environment faculty, as per my nefarious plan for world domination. The inclusion of the first environment student as an editor is only the first step.

Next, I'm going to slowly move meetings from M3 1006 to EV3 1408, which functionally has no difference in terms of size and in fact would make meetings much more compact. Additionally, there is an area in EV3 that is a "designated dining" area, which lets us eat without having to be outside. The only drawback to this is that getting pizzas will take longer—unless somehow taking the bus to Pizza Nova and back is viable. (For the record, I suggested this as a joke when it began raining very lightly while we were having pizza outside.)

And finally, the moment you have been waiting for. Slowly I will populate **mathNEWS** with nothing but Environment faculty students, until we can no longer call it **mathNEWS**, but **environmentNEWS**. Or **envNEWS**, whichever works. The bastion of erudite thought? Now the bastion of ecocentric thought. Muahahaha!

(For the record, this is a joke. I'm not actually going to flip **mathNEWS** from the math faculty to the environment faculty, what would we even write about?)

uknightED

"HELP, ETHERNET WON'T WORK ON MY ARCH INSTALL!"

```
sudo touch /etc/NetworkManager/conf.d/10-globally-
managed-devices.conf
```

jeff

A PUSHKIN SONNET ON MY JOB STATUS

I failed to get a job post grad
My co op left me sad but paid
And tho I'm not at all so mad
I feel like CECA had me played
I heard when you get out of here
You would not know a pain or fear
The jobs would stack forever more
And Google would knock on your door
Though there is one more job that's left
I've had for years I can extend
It gives me food and cash and friends
To turn it down would be a theft

The writer's job is most sublime
So I'll stay here 'til end of time

*meth*NEWS

I HAVE BEEN LIVING INSIDE THE WALLS OF mathNEWS FOR THE PAST THREE YEARS

The last article I wrote was in 2019. I have been crying out for help, but no one has heard me. The editors have not removed my account from the WordPress backend. Waterloo has been changing while I've been stuck in here.

Frat Burger and Duck Lord have gone out of business. Just By Chance Games isn't around anymore. The SLC expansion project has opened. At least several cars have hit the GRT trains because someone thought having train tracks share the street with cars was a good idea.

Send help!

Loquatius

N ARTICLES THAT WERE REJECTED FROM 149.1

- "Canada could be among us the first countries to ratify Sweden, Finland membership in NATO, says Joly"
- "n slurs you can write in **mathNEWS**"

Deriving for Dick

math**NEWS** FACT-CHECKS

Claim: "$a^k + b^k = c^k$" is false for all $k > 2$"

FACT CHECK: True

The fact check is too long to fit into this margin.

Claim: "Open sets are sets that are not closed"

FACT CHECK: False

But the fact that this isn't true is a crime against mathematics.

Claim: "The closure of an open ball of radius R is the closed ball of radius R"

FACT CHECK: False
Not if your metric is discrete :>

Claim: "1 = 0"

FACT CHECK: False

But do we really know? The proofs are convincing. What are they hiding from us!!

Claim: "P = NP"

FACT CHECK: Mostly True
I mean, it is true a lot of the time.

Claim: "math**NEWS** is full of nerds with too much time on their hands"

FACT CHECK: Mostly False

I mean it's true, but we think it's mean.

Claim: "$1 + 2 + \ldots = -\frac{1}{12}$"

FACT CHECK: DANGEROUS DISINFORMATION

Experts have identified this equality as "dangerously threatening to convergence, truth, kittens, and national security". It mighttttttt be true.

Claim: "C is the best language"

FACT CHECK: Completely True

All experts agree. All of them. Join us. Or else.

Fluffiest Cactus

RECONNECTING AFTER THE PANDEMIC

The pandemic has been a massive source of isolation for everyone. Everyone has been alone for two years and now needs to get used to normal life. Returning back to campus, everything old probably seems new again after not being seen for two years. This also applies to people. Two years of isolation provides plenty of time for self-reflection and realizing that you wish to change who you are. Some people are strong enough to do this in public, while others pretend that nothing is wrong. Finally, some people feel like there's no option but to have a fresh start but that always leaves feelings of what you're missing. While the pandemic made everything stand sill, time still passed and changes still happened.

But now, the pandemic is winding down and isolation has ended. You're probably back on campus and seeing people who you used to know but haven't talked to in two years. This is your chance to say hi and reconnect. While you might be scared to know if they accept the new you, they are probably worried about the same. People are always more accepting than you think. Sure, you might have both changed and your connection is faded but it is still there and can be brought back to life.

On the other hand, sometimes one of you has changed so much that the connection is no longer there. It's sad when that happens, but difficult changes are part of life. Sometimes the only option is to say hi and keep walking. While the connection is now gone, your memories remain. You should always treasure them because they helped define who you are. Also, at some point in the future, it might be possible to create a new connection. No one knows what the future might hold.

away from world

If I had too much time on my hands, it wouldn't be 12 PM when I'm writing this.

AN EDITOR WHO IS ADMITTEDLY A NERD

THIS TURTLE IS ON ITS BACK
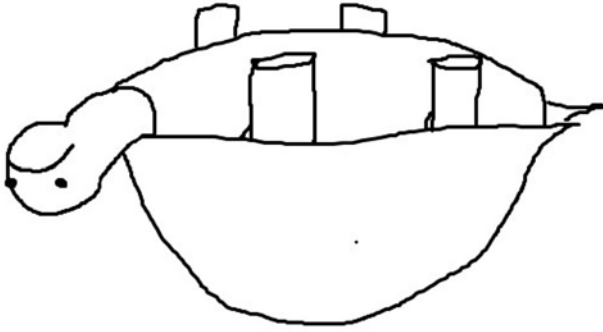
Look at how sad this turtle is.

The most it can move is wiggling its turtle legs in the air, but this does nothing to help it turn back over.

All it can do is wait for death to come sweep it away, whether that be mercifully quickly via natural predators, or painfully slowly via starvation and dehydration.

It is essentially paralyzed, a passenger in its own body, watching the world go by.

The turtle suffers greatly for every minute it is not turned over.

The only way to alleviate the suffering of this poor poor turtle is to turn over your copy of **mathNEWS** and read it upside down. This may seem like a nuisance to you, but to the turtle it is a great mercy. You will have to keep your copy of **mathNEWS** upside down, as the second you turn it back to be the right way up, the turtle will be in pain again. If you happen to be reading this virtually, then the most you can do is kill the tab out of mercy for the turtle.

If you can't do this, I guess you simply don't care about the turtles.

aphf

FROM SPEED, DISTANCE

just a day's travel
but somehow a world away
was it all a dream?

cutlet

MASTER OF TIME

I hate running. I always preferred walking, especially after that time in Grade 8 that I bumped into the meanest Social Studies teacher in the school. One day, my bulky waterproof watch said I was late for class, so I slammed my locker and shot down the hallway, weaving and ducking through the moving morning traffic. As I turned the final corner, I crashed right into him, spilling his coffee on both of our shirts. He yelled at me, and I burst into tears. I was not a tough kid. This surprised him.

"Bad day?" he asked. I shook my head.

"Bad week? Bad life?" He waited.

"I'm late for class," I said to the coffee on our shirts.

He held up my wrist and pointed at my watch.

"Look at me," he said. I looked at him.

"Time cannot be your master. You must be the master of time."

And from then on, I would always walk to class. I also no longer wear watches.

χ

YOU FOUND IT
YOU FOUND IT

You Found It

Xx_420SonicFan69_xX

You Found It

GRIDWORD

RE-RE-LIVING THE PAST
gridCOMMENT *149.1*

It's another one of those days over at **mathNEWS** headquarters, and so we present to you a **gridWORD** of our ancestors: **mathNEWS** 109.4, March 6th, 2009. I've included the attached **gridCOMMENT**, entitled "Re-living the past":

Yay! We've gotten some submissions for my Valentine's **gridWORD***, and they were all kind of weak reasons... This week's winner is.... I have no idea what your name is, but your student ID is kwtseng [A quick WatIAM search is yielding "Katherine Wan-Lin Tseng" — InsidED]! Just drop by Mathsoc at any time when we are open to claim your C&D gift certificate!*

This week is me being really lazy (Notice the no MathCooks?) so it's an ancient **gridWORD** *from way back when dinosaurs roamed the earth! (Or.. something like that. 1975?) Remember to answer the* **gridQUESTION** *and submit your solutions to MathSoc by Monday March 16 at 6pm! This week's* **gridQUESTION**: *How are you dealing with the stress of my unborn child?*

Have fun with this!

REALLY LAZY PANDA

Hmm, it looks like they reused this one too. Some things never change.

god ⚡ peED

ACROSS
1. Complain
5. Extremely thirsty
9. End of John 3:4 (rsv)
13. Laze About
14. Territory
15. Foil
16. One extinct bird
17. A plot of land (latin)
19. Rodents
20. A simple song
22. Cripples
24. 10 decibels
25. Chilled e
27. Diminutive
28. Bodies
32. Vales
34. Earlier than now
36. Mouths
37. Full of ginger
38. To the side
41. The singular of "eros"
42. Fish
44. To lift up
45. Chancing
49. Generally regarded as safe
50. Lash out
52. An appendage
53. An excellent program
56. Stylish
60. Opposite the editorials
61. Fetch back
63. Turkish money
64. Islet
65. Kin -suffix
66. Issue
67. Average
68. Exhausted
69. Healthy

DOWN
1. A bird's toe
2. Rome (latin)
3. Zut ____s
4. Practling
5. Wisely
6. Over regulatory legislation
7. Transfering
8. Of rabies
9. A Caucasoid African
10. Jewel
11. Nerve network
12. A Scottish lake
18. One group
21. Curved glass
23. Fuss
26. Goaded
27. The usual manner
29. "Soars" -deranged
30. By mouth
31. Earthy
33. Italian money
34. At your command
35. Aged
39. Earth
40. Lessons
43. Remote chance
46. A footnote
47. No longer available
48. Clothing
49. Device
51. Peel
53. Fish fork
54. ____ facto
55. Almost near
57. A type of cotton
58. Ireland
59. Grade
62. Not a noun

lookAHEAD

SUN MAY 22	MON MAY 23	TUE MAY 24	WED MAY 25	THU MAY 26	FRI MAY 27	SAT MAY 28
	Victoria Day! 👑👑👑 Shoutout to Queen Vicky for the long weekend 👑👑	Cycle #1, Posting #2 applications close Cycle #1 interviews start		Course selection begins	Final exam schedules released	

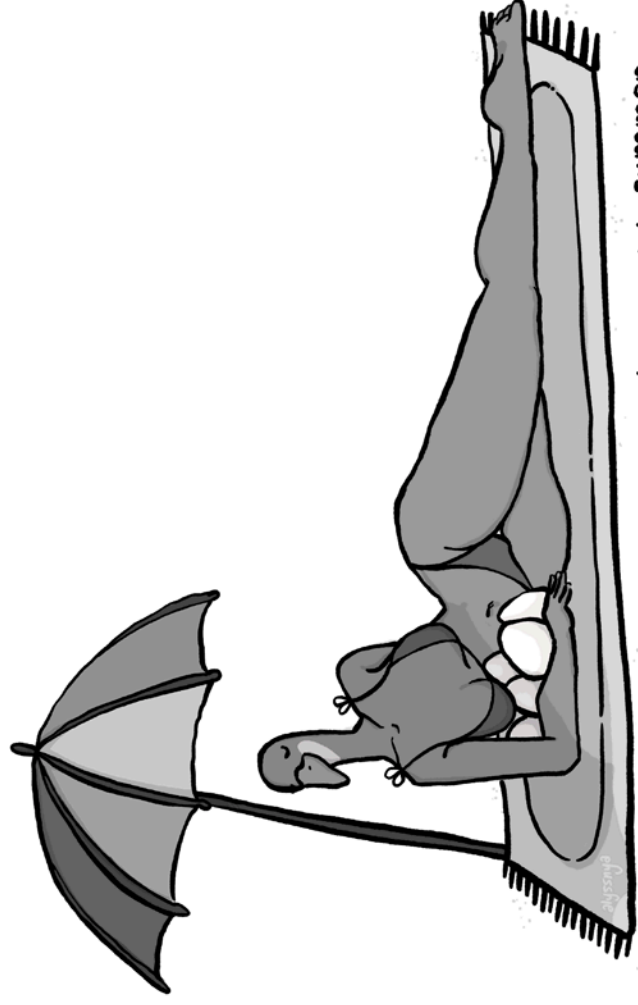| SUN MAY 29	MON MAY 30	TUE MAY 31	WED JUN 1	THU JUN 2	FRI JUN 3	SAT JUN 4
	mathNEWS 149.2 production night			The Vandals invent vandalism by sacking Rome on this day	mathNEWS 149.2 released	

honk girl summer

otherNEWS is made technically possible by club executives of the Math Faculty.

I say "technically" because if they had sent us more news this week, this box wouldn't be here.

THE mathNEWS EDITOR WHO PUTS THE "NEWS" IN mathNEWS