"WHAT'S SOMETHING YOU'RE VERY BAD AT?"

A long time ago, I tried reading *De architectura* by Vitruvius as part of a sporadic interest in architecture. The only thing I remember from it was this part very early on in which the author advises the reader to build cities where it is colder, as heat causes people to become lethargic and useless. He phrased his argument in a very poetic and clear way, it was beautiful. I am overheated.

This **mathNEWS** issue is like a heatwave: you should prepare well before going through it. There will be only brief moments of respite between the wonderfully immersive articles that cover this issue like the gray and voluminous clouds that are definitely not covering the skies of Vancouver, British Columbia right now.

One of these moments of respite is also this terrifying goose drawing that I can't stop looking at, so maybe it doesn't even count as a break, psychologically speaking. But I digress.

For those of us who like numbers going up, five recurring series increment their installment counts this issue, covering a variety of topics from cryptographic puzzles to suspiciously smooth job-interview processes. Wait, it's actually *six* recurring series, but **sexNEWS** doesn't do the numbering thing.

And if those weren't enough, writers tendstofortytwo and aphf have both put out great little stories this issue. Diversity of writing really shines through here; go out and satisfy that varied and adventurous palate of yours. Or you could skip to the **profQUOTES**. Not that I blame you. There's a really good one this time.

No, I swear I don't blame you. Don't look at me like that.

And to clear your head and bring you back to earth, me comes bearing sage advice on time management and personal health. Great for if you've been feeling woozy and detached from your schoolwork/co-op responsibilities, heat-related or otherwise.

Is it even hot in Ontario right now? Do I sound totally out of touch?

Well, whatever. Enjoy the issue. It's a good one.

bipED
Editor, **mathNEWS**

PREDAP	Remembering Prod Night, apparently!
WALDO@<3.LE-GASP.CA	Remembering to take my medication so I can improve the things I'm bad at.
APHF	Operating on lung cancer
ME	Making A cool pen name
BOLDBLAZER	Withstanding temperatures that feel above 40°C. Damn this heat wave.
DERIVING FOR DICK	Describing what I'm good at.
A COOL PEN NAME	Coming up with original and witty **mastHEAD** answers
TENDSTOFORTYTWO	Following schedules — brought to you by, "I need to do my MATH 239 assignment due tomorrow after prod night."
PSYCHGOOSE	Staying on track during an online term; don't give my so much freedom
CC	Spending less time online
FINCHEY	Describing what I'm bad at.
CLARIFIED	Thinking up **mastHEAD** questions.
BIPED	Clicking on things in InDesign
GOD ⚡ PEED	Not abandoning ideas the moment I have to execute on them.

ARTICLE OF THE ISSUE

Congratulations! The article of the issue goes to *Archaeology*, by aphf.

What legacy do we leave behind in thousands of years, when everyone you know will be long dead, and when even our most magnificent structures will be worn away and crumbled to dust?

The answer might be closer than you think. Read the article to find out.

To aphf, your prize this week is an existential crisis about the passing millennia.

god ⚡ peED

If you want to see the **mathNEWS** cover aphf refers to near the end, may I direct you towards our last issue, **mathNEWS** 146.3? (https://mathnews.uwaterloo.ca/wp-content/uploads/2021/06/mathNEWS-146-3.pdf)

Brought to you from my basement.

RETROSPECTIVE: SUPER LITTLE BUG

>>> Play it here: https://chilitrumpet.gitlab.io/bug

cy:

I began work on this game four weeks before the fourth prod night, while girafarig was working on *leaving home*—so, yes, we broke the rules for this one. But it had to be done if we wanted a platform game. In the first installment of this series, I said we had everything "minus physics but I'll cross that bridge when we make a physics-based game." Well, now the bridge has been crossed. Of course, platform games mostly use fake physics, so it's not like I wrote a full-blown physics engine. To give you a sense of how little physics this game actually contains, I searched up the kinematics equations exactly once in the making of it.

I spent pretty much the first two weeks just working on the physics alone. It was the core of the game, after all, so it had to "feel good". Even though the concept is simple, there are a lot of ways you could approach the jumping. The two platform games I'd played in recent memory were *Super Meat Boy* and *Celeste*. Both are good games, but I'm way more partial to the former (plus I didn't want to implement dashing), so I decided to model our game after that. And by "model," I mean "take entirely," basically, if you couldn't tell based on the title.

Just getting a player that could "run" and "jump" with gravity was pretty easy, although it played like garbage. So after that came a lot of tweaking. Instead of setting the player's velocity directly, we used "acceleration" to make it feel natural. The jump had to feel bouncy, and you had to be able to do a range of jump heights by holding down the spacebar for different intervals. The player also moves faster on the ground than in the air, to simulate "air resistance".

Getting the wall jump was difficult. It had to behave the same no matter what the player's current velocity was, which meant instead of using acceleration, I set the y velocity directly. Then it was a matter of changing this value until I got a number that actually allowed me to wall jump.

girafarig also asked me to implemented a buffered keyboard, so that jumps don't have to be frame-perfect; you can press the spacebar up to three frames before the player hits the ground or wall and you'll still jump. I didn't think this was necessary, but after implementing it, I see that it improves playability a lot.

As you can imagine, managing the state of the player in this game is crucial. After a few days of working, the state was so tangled up that every time I added something new, I'd added a bug too. I turned to the book *Game Programming Patterns* to help me, and I tried to use the "State Machine" design pattern, which is meant for exactly this situation—except when I looked at their DFA diagram, I didn't see a way for a player to get from the "Jumping" state to the "Standing" state which is pretty important. And logically, that transition doesn't come from input, it happens when the player collides with a floor.

So I took the idea of the "State Machine" but modified it so it wasn't based on input. Instead, it updates each frame based on logic. I'm pretty sure girafarig added the code to play the audio right into here as well. I try not to think about that.

The game loop is also different in this one. Usually, I use the variable time step loop, because our games were simple before and we only used the timer for basic animations. But with physics, this makes the game non-deterministic. I instead rendered this game using a fixed time loop at 62.5Hz, which was completely arbitrary. *[Note from after prod night: This was my demise and was the cause of a very significant bug. Don't cheap out on your game loop, kids!]*

Of course, for a platform game, a GUI level editor is vital. I only had four weeks, so I wasn't going to write one. Instead, I turned to my favourite GUI image editor of all time, Inkscape, a vector graphics program. This actually isn't the first platform-ish game I've written, so I already knew the strat beforehand: SVG files are XML, and in addition to the GUI editor you can also directly edit the XML in Inkscape. So, our "level editor" is making rectangles in Inkscape and modifying their attributes to distinguish which objects they represent, then running a really scrappy parser I wrote in Python. I hate that language. The parser turns the SVG files into JavaScript files. Yeah, I said JavaScript, not JSON. That's because I wanted to make use of constants that I defined in a different file.

I haven't yet talked about our process for making art for these games. Now would be a good time to do it, since art is extremely important for a platform game. Adding even just a bit of animation just makes the game "feel" so much smoother.

Here is how the process usually goes:

- I make placeholder Inkscape art while programming the game
- girafarig playtests the game and and gets inspired by the game and my shoddy art
- girafarig makes a few sketches and I get inspired by them to get a general sense of the art "direction" or "theme" for the game
- girafarig makes the rest of the art with some of my input
- I post-process the art

Neither of us are artists, so it really takes both of us filling each other's gaps to get the art done. For instance, once girafarig showed me his ladybug sketches, I knew instantly that we needed grass! Flowers! etc. Then I had to turn all of his sketches into vector art. The post-processing part is quite tedious but also exciting. In a previous game I had to clean up and thicken all the linework in his sketches. I feel like an assistant in a manga studio.

I wanted a lot of cool effects in this game. I think it's mostly because everyone's seen a platform game at least once, so it's not inherently exciting. *Celeste* in particular is sparkly

and flashy. I needed to make it look at least a little nice if it was going to be any impressive at all. So I added a parallax background, clouds, and the moving texture for the goop stuff. Because I'm implementing this all in Canvas and not WebGL, it's not very efficient. I had to reduce the amount of draw calls each frame as much as possible.

I was doing this all on my X220 because girafarig was ~~gaming on~~ using his gaming computer, and it kept running to 80°C. I would playtest for half a minute, close the tab, and wait for my laptop to cool down again.

There was a funny thing when implementing the parallax background; it ran terribly in Firefox but not in Chrome, even on girafarig's gaming computer. I would eventually add a plain graphics mode for people on X220's but I didn't want to require all Firefox users to use plain mode, too. On a whim I rounded the parallax background coordinates down to an integer and that fixed it. I got this trick from a very old webpage on how to speed up Canvas animations, even though the page had said that most of those tricks might be outdated.

Addendum after having playtested the game with writers at prod night: There were a few bugs that made the game impossible to play. Unfortunately, I think that ruined the experience of the game for some people. We were able to squash them, although it was after everyone lost interest in it. Oh, well. That's what the playtesting is for, anyway. I hope your experience is bug-free — well, except for the titular bug, of course.

girafarig:

Making a platformer is such a huge pain in the ass it's unreal. I don't know why everyone wants to make one, why it's considered, like, a good starting project for the aspiring game developer. From the very beginning we had wanted to make a platformer, but I knew to wait until we had a lot of free time and to start on it earlier than usual — still we had to crunch on the game at the very end. This game isn't even that long.

I'm sure cy has told you all about the technical aspects of getting the physics to tell the right lies to the player so that the titular bug feels fun to play. I think we did a good job in the end, after a painstaking process of trial-and-error, though maybe you accelerate too fast when running on the ground. It's kind of hard to control. Hot tip: you should be in the air most of the time in this game, as you get more precision while still going fast. I've tried to teach that skill through the level design somewhat, though I don't think it fully came through.

Speaking of level design, I worked on the first level and helped out with the second. (It originally was supposed to be all my

job, but I started getting really nauseated when doing it for some reason and had to stop.) My strategy here hasn't changed much from *leaving home;* I basically just made some big shapes and filled it with obstacles, going mostly off intuition. I tried to steal as little as possible from *Super Meat Boy* while I did this, but it's a bit hard, it's not like this game is some radical re-imagining of the platformer genre. Or even that different from *Super Meat Boy* really, it's almost a clone of that game. (cy and I both really like that game, which is why we made *Super Little Bug* in the first place.)

God, I'm rambling on and on. Blame the heat.

I also did the art. We had a two-step process where I wack out some rough pixel-art drawings, and then cy re-does them in vector format. This is because neither of us have any dexterity when it comes to drawing; I'm pretty okay at getting the idea down, and cy is good at making vectors, so our process mitigates that issue. I'm really happy with how the strawberries came out. They have a real weight to them. It was my idea to make them really big, I wanted it to feel like *The Listening Room:*
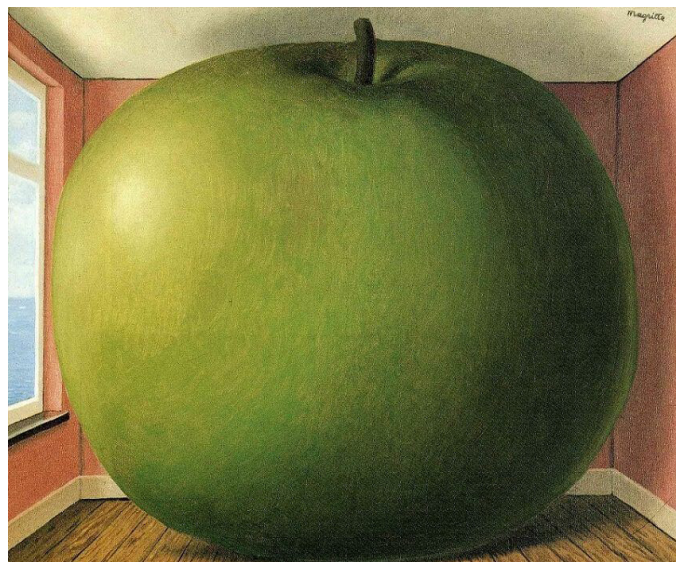
Otherwise, cy was in charge of art direction, and I just drew what was asked of me. A lot of the big-picture stuff like the grassy theme and the moving hazard texture was cy's idea. I did come up with the ladybug protagonist first though, which was what kicked off this direction for the art. I also drew the cover on a whim.

I really like this game, despite having done nothing but complain about it. The art is good, and I guess platformers are just fun. But it feels like a lot of people who make

platformers don't really play them, you know? Like I went to this exhibition by an art school near me, like everyone's grad projects. The most memorable one was this platformer someone made, it was like a *gone home*-esque artsy game and the plot and art was good, but the feeling of actually playing it was terrible. I don't know why they didn't make like an RPG maker game or something, those are impossible to bung up. I don't know where I'm going with this. How about I stop talking now and you go play the game again.

Addendum: Playtester feedback for this game has been the most mixed of all games so far. There were some performance bugs that didn't help, but a lot of people didn't mesh with the 'very hard platformer' genre. I'll deflect some blame here; since the game had to be short I needed to ramp the difficulty quickly, or else the game would have been terribly dull. But I overlooked a major annoying difficulty spike near the start, which certainly put off quite a few people — 100% my fault. That's been patched up a bit, and the performance issues have been fixed.

cy and girafarig

A CUTE GOOSE

Cix

GOOSE IN THE GRASS
TO THE TUNE OF "HEART OF GLASS" BY BLONDIE

[Verse 1]
I spotted something at the end of a class
Soon turned out was a goose in the grass
Seemed so adorable, only to find
A terrible beast, blight to mankind

[Verse 2]
Once I saw a goose and it looked so kind
Soon found out it was not benign
It seemed so harmless but I was so blind
A terrible beast, blight to mankind

[Chorus 1]
DC green
In the midst of spring I was feeling fine
I was only passing when I got entwined
In a fight so vicious it was just pure luck
To make it out alive

[Verse 1]
I spotted something at the end of a class
Soon turned out was a goose in the grass
Seemed so adorable, only to find
A terrible beast, blight to mankind

[Chorus 2]
Almost died
When that goose attacked me and went for my eye
I kicked it with my leg and ran back inside
Caught a glimpse of its eggs, yeah

[Bridge]
Ow, my thigh, but at least I was able to save my eye

[Verse 3]
For the rest of the day I was in a cold sweat
If there's something I've learned, geese should never be pet
It was so cruel, you'd never bet
But now I kinda want a goose omelette

Finchey

EPISODE 22: COMPARISON TESTS

Enjoy Episode 22 of the MathSoc Cartoons series: Comparison Tests! Want to see the next comic when it's released? Follow @ mathsoccartoons on Facebook or Instagram! Want to see the next comic BEFORE it's released? Sign up to be a Reviewer at bit.ly/mathsoc_cartoons_reviewer_signup! As always, feedback, suggestions, and fan art can be left at cartoons@ mathsoc.uwaterloo.ca.

MathSoc Cartoons

MATH 138: COMPARISON TESTS

STORY + ART BY: GRACE FENG

Panel 1:

CHALLENGE START! AVOID THE EVIL PIXIES' SPELLS!

YOU PICKED A **FAIRY**? AREN'T YOU AFRAID OF BEING **WEAK**?

NOT FOR THIS CHALLENGE! FAIRIES CAN DODGE THE EVIL PIXIES' SPELLS THE BEST!

Panel 2:

THE SPELLS WILL EITHER **CONVERGE** IN THE MIDDLE OF THE SCREEN OR **DIVERGE** TO THE EDGES. ALL WE HAVE TO DO IS AVOID THEM BY FIGURING OUT WHAT SPELLS THEY'LL USE!

...HOW DO WE DO THAT?

WAIT, THESE PIXIES LOOK FAMILIAR...

Panel 3:

WE USE THE **COMPARISON TEST**! LOOK AT THE PIXIES ON SCREEN. THEIR SPELLS ARE REPRESENTED BY **INFINITE SERIES** THAT ARE:

$$\sum An = \sum \frac{sin^2(n)}{n^2} \quad \text{AND} \quad \sum Bn = \sum \frac{1}{n^2}$$

WHERE WE KNOW THAT BOTH THESE SERIES HAVE **POSITIVE TERMS**.

I KNOW $\sum Bn$ IS CONVERGENT, BUT $\sum An$ LOOKS DIFFICULT.

Panel 4:

WELL, WITH THE COMPARISON TEST, WHEN WE KNOW $\sum Bn$ IS CONVERGENT, AND $An \leq Bn$ FOR VERY LARGE VALUES OF N, THEN $\sum An$ CONVERGES.

$$0 \leq sin^2(n) \leq 1$$
$$\frac{0}{n^2} \leq \frac{sin^2(n)}{n^2} \leq \frac{1}{n^2}$$

IN THIS CASE, SINCE $\sum An$ IS LESS THAN $\sum Bn$ BOTH THESE PIXIES' SPELLS WILL BE **CONVERGENT**!

Panel 5:

TOOLTIP: THE COMPARISON TEST USUALLY INVOLVES TWO POSITIVE SERIES.

Panel 6:

HERE'S TWO POSITIVE INFINITE SERIES, BUT WHAT IF I KNOW $\sum Bn$ IS DIVERGENT?

$$\sum An = \sum \frac{1 + sin^2(n)}{n} \qquad \sum Bn = \sum \frac{1}{n}$$

WHEN WE KNOW $\sum Bn$ DIVERGES, BOTH SERIES ARE POSITIVE, AND $An \geq Bn$ FOR LARGE VALUES OF N, THEN **BOTH SERIES DIVERGE**! THE SPELLS ARE DIVERGENT!

TOOLTIP: PAY CLOSE ATTENTION TO THE **COMPARISON SIGNS**!

MATHSOC

MEF — Mathematics Endowment Fund

MATH 138: COMPARISON TESTS

STORY + ART BY: GRACE FENG

THE OFFICIAL OLYMPIC GAMES APP

Every edition of the Olympic Games has its own app to accompany it, be it Winter, Summer, or Youth. The Paralympics don't get a separate app since it shares the same app as the Olympics and just gets an update with basically a new skin in between. These apps are made by the organizing committee of each Olympic Games, not the International Olympic Committee (IOC) itself.

One thing I always go through whenever I download the Olympic Games app is to check the list of participating nations. Usually there will be some content associated in that list, apart from the basic stuff like the flags, names, list of athletes, and medal count. Typically there will be some paragraphs on that nation's history at the Olympic Games with some trivia bits mixed in. I usually end up going through all of them.

The 2016 Olympic Games app was no different in that regard. I downloaded it and went through the app, but I noticed something odd. When I tapped on the info for the Democratic People's Republic of Korea (DPRK), the entire section was blank. There was no content. I then checked the section for the Republic of Korea (ROK). The accompanying information was there, but it was all about the DPRK instead. The app had a mistake!

This mistake wasn't just on any old two countries. It was a mistake about the DPRK and the ROK. Recall that there was an incident that happened at the 2012 Summer Olympics where the DPRK women's football team walked off the pitch when the ROK flag was used on stadium screens when displaying the DPRK athletes. That incident made the headlines.

At first, I did nothing because I expected this mistake to be fixed within a couple days, but it remained there for weeks. The app even switched over to the Paralympics and yet the mistake was still there. At that point I figured maybe this was something I should warn them about before the Paralympics itself finishes. So, I went to the app store and left a review telling them of the mistake. The next day, they left a reply thanking me for pointing it out and that the information was corrected.

I went back to the app and finally both Koreas had the correct information. Thankfully, this time it was corrected before it even had the chance to make it to the headlines.

☞

A separate stand-alone app for the 2020 Olympics has not been released. Instead, the official Olympics app was updated to double as the official 2020 Olympics app. This is similar to what some other sports do, but new for the Olympics. Looking through the app, it looks as though it will double as the 2020 Paralympics app too even though the Paralympics are run under the auspices and in the jurisdiction of the International Paralympics Committee and not the IOC. There is a button to switch between the Olympic Games and Paralympic Games in the app. Switching just updates the type of information shown such as the list of sports, but it does not change much of the colour scheme of the app unlike previous Olympics apps.

I expect that there will be no major errors this time around as this app is made and run by the IOC itself and not the separate organizing committee. I bet the IOC takes special care not to make such a blunder. Although, whether the Olympics will start and finish without a hitch is yet to be seen.

boldblazer

prof**QUOTES**

ENGL 306A: CLIVE FORRESTER

❝ If you are from computer science, you will spend your whole day doing your coding… and then you forget a space, and what you produce is trash!

MATH 239: PETER NELSON

❝ Of course, I'm also a mathematician, so I'm contractually obligated to show you what the rules really are.

❝ Remember, that this really is black magic.

❝ The next slide will contain a huge Greek salad of formulas.

❝ Row-reducing matrices is not in my job description, so I'll get to the point.

SURVEY ON RESOURCES FOR POST-SECONDARY MATH COURSES

Hi, I'm Gavin. I'm a MathSoc Director and a MathSoc Cartoons director this term. I'm looking to collect feedback from students who are taking math courses about how their courses have been going both before and during the pandemic, what additional resources they would like to see, and the quality of the work that was produced by the MathSoc Cartoons project. If you have any feedback to provide please fill out the survey at this link: `https://forms.gle/NmNZ1eeyVSmRUax69`. Thank you!

Gavin Orok

sexNEWS: RELATIONSHIPS AND SEX

Welcome back to **sexNEWS**, a biweekly column in which I answer relationship advice questions submitted by you, the readers.

As always, feel free to send your questions to mathnews@gmail.com to be potentially answered in this column. Anonymity is guaranteed[1]. You're also welcome to include additional information to give context that you don't want included in the article if you're worried that your situation is specific enough that fully explaining it would expose you. This column is not restricted to just romantic relationships, we discuss personal relationships as well.

> *When I am at an event with food, can I eat the vegetarian food even if I'm not vegetarian? I always worry that there won't be enough if I eat it too.*
>
> **NOT VEGETARIAN BUT LIKES VEGETABLES**

This is a good question. It depends.

A lot of events will have people with dietary restrictions, including vegetarians, go first. This is great because it makes sure that people who can only eat certain things get their food, and it also means that everyone without dietary restrictions is free to pick from all the food after the people with dietary restrictions go. If the event is like this, then once it's your turn it's okay to pick from whatever food, including vegetarian food, there is. If you have your own dietary restrictions, then just ask to go after everyone else who has dietary restrictions.

If your event isn't having people with dietary restrictions go first, then it's a bit more difficult. First, gauge how much vegetarian food there is. If there isn't a lot, wait until everyone, or at least all the vegetarians, go first. If there is plenty of vegetarian food, then feel free to have some vegetarian food.

If in doubt, ask the event organizers. A good event organizer will know how much vegetarian food there is and also have an estimate on how many vegetarians there are at the event. Also, if the event asks for dietary restrictions beforehand, and you want to eat a vegetarian meal at the time, it's acceptable to put down you are vegetarian even if you're not, **as long as you will only eat vegetarian food at the event**. Putting down vegetarian on the registration and then eating non-vegetarian food at the event isn't advised, since the event planners will assume that you will only be eating vegetarian food and order accordingly.

> *From a heteronormative lens, what are 3 of the better positions to make sexual intercourse enjoyable for both parties?*
>
> **FAP**

This will vary a lot between persons, partners, mood, body type, and so much more. However, what I call "the three classics" are popular for a reason. For most people, they are enjoyable positions that are easy to do. The three classic positions are:

- Missionary
- Riding/cowgirl
- Doggy style

These are good positions to start, and then experiment from there to find out what you and your partner enjoy.

> *What is the best position for my [REDACTED] to be [REDACTED] at so that it feels [REDACTED] and [REDACTED] on a [REDACTED]?*
>
> **FAP**

[REDACTED BY TYRANNICAL EDITORS] *[Editor's Note: Ouch.]*

> *I like having heated debates with people. I did that with a roommate once, and he ended up taking it personally and was mad at me until I apologized. But I have also had some really spirited and enjoyable discussions this way. How do I better identify people who are willing to have such debates?*
>
> **NAME** 👍

I would advise that if the debate is getting heated, you take a pause and check in with the other person that they want to continue. Some people really enjoy arguing for their beliefs, and some people just like to play devil's advocate and argue for the sake of arguing. Some people don't like debating. It will also depend on the topic. Someone might enjoy having debates about some topics but not others. So even if the person you're debating with has said they enjoy debating before, it's still good to periodically pause and check if they want to keep going.

Senior **mathNEWS** *Relationship Correspondent*

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1. Unless there is a court order or something, but if I foresee that being an issue I probably won't answer the question in the first place. Canada has unfortunately weak laws protecting journalists, and I don't know if this column even counts as journalism.

> # The meat is hard... Maybe we should do vegetarian proofs, skip the meat.
>
> PROF. IAN MUNRO

warSOC VII — B-SIDE

My hopes that we'd pull it off unnoticed vanish with my spotter's honk.

Sighting. It's Hawk. I follow my spotter's extended wing and sight the approaching figure.

Stay calm. We need to buy time, I say to my flock. Hurry up, Lucy, I pray. They're onto us. Dark skinned, long haired, and with the face of a predator, the human woman glides towards my formation, an easy target to see against the bright yellow fractals of Theorem-Space. A dozen concentric spheres of revolving symbols surround her; shielding against our attacks in an unusually dense potency. My flock hisses angrily, fearfully — she's devolved or killed so *many* of my geese over the two years we've been operating. My geese call her Hawk. **warSOC** has brought their finest. But so have I. We're the Arith Division, Lucy's best and brightest.

Split intercept, I order, and with practised precision, half of my forty geese follow me out of the circling holding formation like a droplet sliding off a leaf. Harsh war honks fill the shifting air of Theorem-Space around me. The honks are louder than usual, verging on desperate, and the fear of my flock is palpable. My tongue is dry, which makes it harder to say the incantations that bring my own shielding problems to life around me. Around me, geese are doing the same, but the problems look simple, almost childish compared to the fortress surrounding Hawk. *For Lucy!* I shout, and the Division joins me in the cry.

When we are a hundred spans away, Hawk strikes. She twirls like a ballet, swinging her pink tie about, and a thunderclap crack accompanies the lighting bolt of Anti-Mathematics that cuts straight through Penrose flying next to me. I see his shielding problems melt, see the ferocious contradictions tear apart his mind, and the light in his eyes fades as he convulses and spins out of formation. How does she do math that fast, and that well?

Break and strike! I shout, and my twenty-odd geese scatter and dodge and start hurling their own Anti-Math at Hawk.

We can't do this! Dyson, the new goose in the Division, is honking at me from my other side, terror in his eyes at the fate of Penrose. He's turns tail.

With a sharp turn, I catch his feathers. *This isn't for us, remember? This is for* Lucy. *We need to hold Modern Languages' Theorem-Space, or they'll catch her.* I don't have time to keep talking. I can only hope no-one else runs with Dyson.

I swoop back towards Hawk, and shout a small Anti-Math attack. she's busy taking out Conway and Hilbert, facing away from me, and I guide it into her shielding problems. Stupid 0–1 knapsack. I curse and start chipping away, trying to solve the optimization problem. My entire flock is doing the same, guessing, solving, desperately trying to take Hawk's problems apart before she takes *us* apart. Her face is a mask of still calm.

With another hideous *crack*, Hawk impales Conway and almost gets Hilbert too. *Spread out!* I yell. My throat is hoarse and my head hurts from the solving, but we're getting through. Hawk spits a dozen smaller instruments of Anti-Math, one of them directed towards me, and it takes all my concentration to disprove it before going back on the offensive. It's working! I tear through a layer as several of my geese do the same, and savage pleasure fills me as Hawk's composed expression slips.

"Contact! Contact! I need help here! They're going all out on my shields!" She shouts something incomprehensible in the humans' foreign language. Foreign — for now, that musing part of me corrects.

I close to three spans' distance, the edge of her shielding, and strike again and again. My flock smells blood, but more importantly, *revenge.* Hawk's yells turn even more frantic as another shielding layer goes down. She's on the defensive

now, throwing up problem after shielding problem. I tear apart another, and another, and I'm about to take down the last when my spotter yells again.

I chose Maxwell as my spotter for her voice. The honk cuts across the battlefield; a clarion call. *Sighting. Elder and both Doubles. Three hundred spans.* Which is disastrous if Maxwell's not mistaken, and she won't be. Elder is **warSOC**'s leader, extremely skilled and dangerous. The Doubles are identical-looking humans, and fight with deadly speed and synergy.

My half of the Arith Division is bunched around Hawk, an easy target for the Anti-Math. *Break!* My geese have just started to turn when Elder's first attack arrives. Where Hawk's are loud, sudden cracks, Elder's are oppressive waves of mind-eating destruction. *Four* of my geese disappear beneath the deluge. I try to dodge, but the attack still clips me and my thoughts immediately start to melt.

I hear screams. My wings fold and I drift, trying to save all my energy to fight the rot Elder's put in my mind. I don't think I'll die, but if I lose this mental fight, I'll devolve. Back into a mindless, aimless, goose.

The screams aren't human. They're my geese, trying to stave off insanity. I'm very, very tired all of a sudden. I see Laplace, my second-in-command, leading the other half of the geese into the fray. They dodge and weave around waves of Elder's, bolts of Hawk's.

Have you ever heard a goose scream? The contradictions are closing on me. Two identical figures, the Doubles, dart through my forces, distracting and disrupting with quick moves. Their Anti-Math is bright and sharp, like glints of a falling dagger. Bodies of geese drift and spasm. This is as good a battle as any to die in, I figure. I just hope we've bought enough time for Lucy.

I've somehow drifted close enough to Lucy's extraction point so that when it happens, I see it. Lucy falls through a portal in Theorem-Space, and I'm briefly elated until I see two human women follow. One's unconscious, but to my horror, the other, an auburn-haired woman, is awake, and *completely without a pink tie*, soaking in the pure, potent power of Theorem-Space, and already preparing an attack. The human will surely die or devolve from the exposure to Theorem-Space, but it doesn't look like she cares. Lucy's pink, skeletal figure is ruffled and panicked as she flaps away as fast as she can.

Lucy shouts something in the human tongue. "You're… You're insane, Sarah!" I don't know what the words mean, but the fact she's speaking human means she's pulled it off.

But Lucy's not fast enough. A small, unassuming dart of red Anti-Math shoots from auburn-hair's finger. Lucy tries to dodge left, but the auburn-hair's anticipated. Elder's waves, Hawk's thunderbolts, Doubles' daggers, have nothing on the ensuing Anti-Math explosion that feels like it shakes the essence Theorem-Space itself. Lucy is dead centre.

Lucy. I can barely speak, but with a new determination, I fight off the last of the Anti-Math in my head and raggedly flap to her side. A glance behind me confirms auburn-hair has succumbed to Theorem-Space. Lucy's elegant features are still, and she's curled into a ball of pink feathers.

Fall back! My voice is hoarse and weak, but Laplace catches the command and relays it. The comforting sound of flapping wings surrounds me as I'm carried off with Lucy. I catch **warSOC** flying to auburn-hair, gathering around her. A hint of the same protective nature in all of us, human or goose, I muse, before finally, unconsciousness takes me.

To be continued…

CC

I WOKE UP TODAY TO WINDOWS 11

A TWO MINUTE REVIEW WRITTEN TWO MINUTES BEFORE THE math**NEWS** *SUBMISSION DEADLINE*

it auto-updated arrgh this is what I get for joining the beta program huh oh no the taskbar's locked at the bottom and my windows are curvier than usual the icons are sus but I mean the snapping feels really fast and incredibly good for some reason holy smokes the snap layouts are epic I guess I'll live
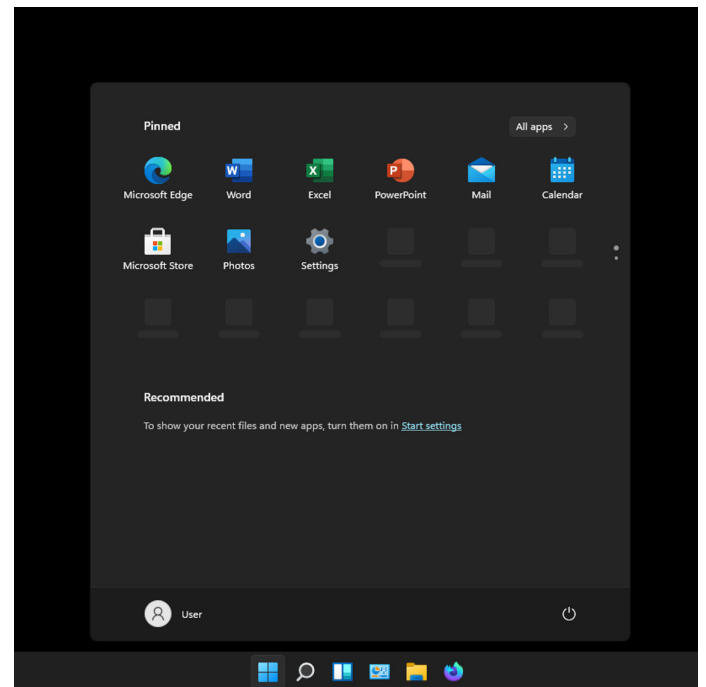
CC

yes my username is user deal with it

ARCHAEOLOGY

You have long been searching for relics of an ancient civilization. Their ultimate demise occurred thousands of years prior and it was as fast as it was mysterious. Very little of their culture or works or architecture remains, and what does remain is barely indicative of anything at all. Entire nations were wiped off the face of the Earth by forces as powerful as they were ancient, and have been long forgotten. In the academic circles you frequent, it is up to debate as to whether this ancient civilization ever even existed. Most are convinced it is just a myth. Not you, however. You know these people existed long ago. Somewhere out there, there is proof. Hidden beneath layers of bedrock there will be some artifact, you are certain, or deep in some table of data there will be an unexplained trend. You are certain the proof exists, you have yet to find it.

You have been searching through samples of dirt taken from a region on the western continents. The actual location is to the north of a series of vast dried up seas, which in ancient times would have been teeming with travel and trade. Food to sustain millions would have been shipped up and down these seas by ancient ships, ships as big as buildings, lost to time. Since then these seas have dried up. Now they are vast basins of limestone and dust, devoid of life.

Something was odd about one dirt sample in particular. It had a very high amount of fossil-based polymers. Not so high that it would convince anyone in your academic circles, and certainly not high enough to convince any member of the general public, but high enough to be noticed by your keen eye. You have now come out to investigate. Getting here was a challenge. The transport networks on this continent are underdeveloped, so it took days for you to trek here from the nearest hub. Now here you are, digging up soil to try and find something, surrounded by tall pines hundreds of years old. The pines aren't the oldest trees in this forest, they eventually grow too tall to uptake water all the way to the top of the tree, causing them to die slow deaths over decades. The dwarf cedars, on the other hand, are thousands of years old. In theory, they could have been around in the times of the ancient civilization. The bugs swarming you and biting you are also unchanged in thousands of years, and the air is thick with them.

Your shovel hits something. It is not hard, but it has a different texture from the dirt. You pull it out. It seems to be made of layers upon layers of a thin film, presumably some sort of polyethylene. You begin to peel off the layers, one by one, which are packed so tight together there is not even dust between them. Something is encased within the centre of these layers, you are certain.

And you are right. At the very centre of these hundreds of layers you have found it. This is proof, proof enough to convince the academics, the public, the government, everyone. It is sheets of paper, made from ancient fibers that would have disintegrated long ago if not for the protective packaging. The front has an ancient script. It looks like Latin, and is written in Latin letters. Under the writing is a depiction of two creatures. Perhaps gods to these ancient people? Maybe this page is some sort of offering? Maybe part of a ritual thousands of years old? These questions haunt your mind as you consider the humanoid depicted here, and the bird next to her. The species of bird is presumably long extinct, and the humanoid is not like any humanoid you have ever seen, it seems to have animalistic ears, as well as human ones. What is the purpose of the second pair of ears, which resemble those of a hare? Why the human ears as well? Certainly it only needs one pair, that's enough to determine the origin of a sound in a three dimensional space. And the text. What does it mean? As far as you know, "**mathNEWS**" has no meaning in Latin.

aphf

RATING SYNONYMS FOR "ERECTION"

phallus - 9/10, starting off strong and powerful

erect penis—1/10, try harder

tumescence—8.4/10, elegant

tumidity - 6.7/10, not elegant

turgescence - 7.5/10, less elegant

hardness - 4/10, needs more commitment

rigidity—8.9/10, the syllables, the vowels!

stiffness—5/10, average

firmness—5.6/10, slightly above average

hard-on—3/10, somewhat immature

stiffy—9/10, Mr. Stiffy

boner—7/10, you can't take this word seriously

ramrod—4.5/10, who said that

horn—1/10, bad

Deriving for Dick

MathNews

TIE GUARD PART 4: INTERVIEW

Sliding into the chair across from the interviewer, Bhavya tried to put on a brave face. She was interviewing with BlackBox, and today was the day that she would finally try to ascertain their motives. She had gotten through the coding challenge with ease; it was just a fairly standard LeetCode problem that, while difficult, had caused her no problems.

"Hi, I'm Bhavya," she said with a smile, extending her hand.

"Hi Bhavya, I'm Eric," the man on the other side of the table responded. He had an intimidating aura, back ramrod straight against the chair, and though he smiled it was an unsettling one. "Glad you could make it to the interview," he continued.

"Glad that you chose me," she replied.

"I'd like to start by asking you about some projects that you're proud of," Eric said.

Bhavya cleared her throat, and started to answer. The interview progressed; Bhavya intentionally flubbed some of the questions so they wouldn't actually hire her, but she thought she did it well enough to not be noticeable.

Eventually, the interview started to come to a close. Eric smiled and clapped his hands. "Well, Bhavya, do you have any questions for me or the team at BlackBox?"

She nodded. "I was wondering, actually, I went to the address on your flyer and it didn't seem as big as the position would indicate. What's up with that?"

Eric hesitated for a fraction of a second before answering. "Ah yes, that's just our old office. We've been moving into a new office and we must not have changed the address on the pamphlet. So sorry."

"And where would this new office be located? I'd want to know since, after all, I'd have to be working there."

"Yes, um," Eric coughed. "It's just off the ION line near the Hospital."

Bhavya nodded slowly, considering. Sure, that was a possible explanation… but it didn't seem right.

"Is that all?" Eric asked her.

"Can I send any further questions through email?" she asked.

Eric handed her a business card. "Of course, here's a card. Send any questions to this address."

Scrutinizing the card, Bhavya thought the email looked… strange. The domain name didn't quite match up with the company's website; blackbox.corp instead of blackbox.ca.

Bhavya smiled. "No, that'll be all."

☙

Back at her dorm, Bhavya typed blackbox.corp into her laptop. And it redirected… but not to blackbox.ca. She sat back in her chair, momentarily surprised… but it all made sense.

"Huh."

Predap

PMC PROBLEM 5: BENEDICT CUMBERBATCH

Hey math-folk!

Let's switch gears this fortnight to the study of secrecy and intelligence; in other words, CRYPTOGRAPHY and Benebottom Cucumber's razor sharp cheekbones.

To be honest, these problems are my only motivation to keep doing math while my soul gets sucked out during co-op, so the themes tend to stick to whatever I'm reading that week. So thank you to everyone who's been keeping up with this half-blog, half-POW (get it? because it's once every two weeks :3) train ride.

This week, I've got a fun teaser that no mathlete lesser than Alan Turing himself could solve… at least, *so far*. Try your luck! Inspired by *The Code Book,* by Simon Singh.

caesar
YLJHQHUH
WMGPR, WVGJVJ
84 44 67 48 58 25
OIE XUPV RNS?

Happy problem solving!

VP Propaganda, PMC
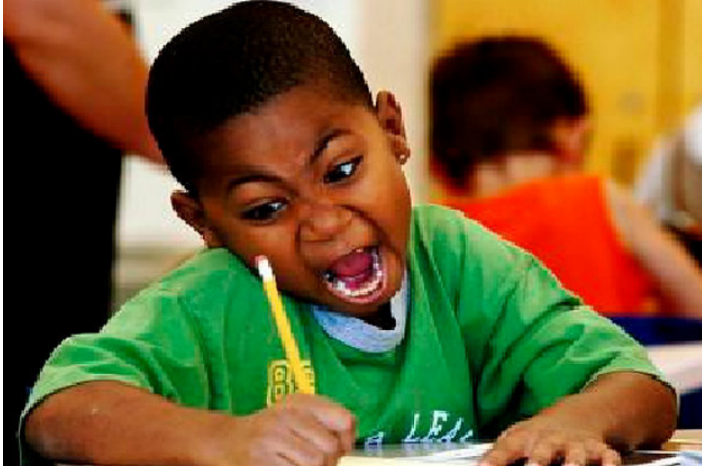
Hint 1: the cipher name tells you the cipher key.
Hint 2: Google is encouraged.
Hint 3: www.101computing.net is helpful for the last line.

What, do I look like a cryptographer?

PROF. DAVID JAO

DO NOT PULL AN ALL-NIGHTER BEFORE A MIDTERM EVEN IF YOU DID NOT STUDY

A tough habit to break, a few people including me forged this habit during high school when the weight of the exams was much lower; the exams were shorter and easier than the university counterparts. We managed to get away with studying less than a week before exams and still get good grades. Not anymore. I struggled to break this habit nearly every term and still failed. Especially during this era of online learning when many people are behind on their lectures.

If you were slacking off and did not study until you had one or two nights left, my advice is: do what you can to cram, but go rest before exams. Even a three-hour nap is enough to fit 2 REM cycles. It's not nearly enough sleep, but this might still save you a panic attack, or worse — delirium on the exam. If you choose to sleep, you might still suffer Acute Midterm Regrets (I wrote about it in v133i3, from February 2017) after the exam. You will think that the ⅔ hours you "wasted" on sleeping could've been used to study a section on the exam that would've given you 5 marks. On the other hand, if you choose to pull an all-nighter, you are maintaining this terrible habit for short-term gain. When the finals come, when the upper-year courses come, you will regret it.

Common knowledge (this is left as an exercise for the readers to fact-check) is that science has proven that an all-nighter does not necessarily improve a person's marks that much. Even so, it does leave a detrimental, long shadow of sleep debt that will take weeks to recover. Not to mention the caffeine dependence. Not to mention the long-term health and academic consequences accumulated throughout the term.

It's also unsustainable with multiple exams, assignments and interviews in a row. Surviving one exam is not worth throwing the entire term off track. All-nighters will do that. I have reminisced over how my undergrad would go differently if I broke this habit in my first year. The solution seemed so trivial, all it takes is to study much earlier with a planned routine. Yet it is so hard to implement for some of us. Life happens: a meetup I want to attend; all the food in the fridge goes bad; the roommate from that high school parties all

week. You have a midterm coming but you had to spend all day editing the **mathNEWS** article because the grammar is that bad.

There you are, frantically cramming the knowledge in, kicking yourselves for procrastination. The library / study space is devoid of other people, so quiet you can hear yourself hyperventilate. Feeling so lost, alone, wondering what went wrong with life that brings you to this moment. But you are not alone. I have been through the same nights, countless nights as you are doing right now. My comrades, if you remember this article you happened upon by any chance, remember this please: get some rest. You might be losing the current battle but it's never too late to prepare for the next one.

🛏

(I was supposed to write this article before the midterm season but I procrastinated, so do as I say, not as I do.)

me

RATING SYNONYMS FOR "ERECTION"

construction - 6/10, it is a word

building — 4/10, not reminiscent of erections

putting up — 3/10, lazy

assembly - 8/10, 'ass'

putting together - 3.5/10, slightly less lazy

fitting together - 4.2/10, none of these are great

fabrication — 7/10, the flavor

forming — 5/10, average

manufacture — 7.2/10, syllables

production — 6.1/10, low erection value

raising — 2/10, too on the nose

elevation — 9/10, maybe good by default

Deriving for Dick

THE CAVE OF WONDER

This Harry Potter fanfiction was my final project for ENGL 108P. I asked the professor and it's okay to share with others, though I will warn you that if you try to use this as your own final project, Policy 71 will not be kind.

Once upon a time, there was born a girl called Cassandra, in a family of witches and warlocks. The arrival of a young witch was greatly celebrated in the family, but as Cassandra grew up, she made a dismaying discovery. Despite having magical heritage, by some extraordinary tragedy, no magic flowed in her veins.

As she grew from a bubbly little girl to a charming woman, she spent years poring over magical books, texts, and scrolls, and traveling far and wide to consult with learned wizards. After years of searching for a solution, however, she was forced to admit defeat, and conclude that she was never to wield the powers that she had once yearned for.

However, in the process of accumulating knowledge to find magic, she had slowly fallen in love with the idea of learning itself. So learn she did, now no longer restricting herself to magical sources. She went far and wide, learning from both magical and non-magical texts, runes, and scholars. In doing so, she became very learned and wise.

One day, during the course of her travels, she chanced upon three bravehearted young men, each seeking to bring peace and justice to all who needed it.

The first of them was Shravan, a soldier who had returned from war to find his hometown pillaged, and his mother killed by the enemy. He had sworn that he would not let another child be separated from its mother's embrace. The second was Han, a merchant driven to poverty by the unjust tithes of a tyrant king. He sought to ensure that none around him lived without food or shelter. And the third was Bhat, a healer who had escaped from a ship, wrecked on a coast nearby. He had seen his friends lose their lives to the sea, and vowed to never let someone die under his watch.

Cassandra enquired as to where the young men were headed, and Han told her, "We are searching for the Cave of Wonder. It is said to keep inside whatever a witch or wizard may desire, though none is able to retrieve it. We seek to be the first."

Intrigued, Cassandra asked if she may accompany them to witness this great cave for herself. The men were reluctant at first, seeing her as a burden. But Cassandra had learned from a great warrior the art of handling a knife, and once she had shown that she was capable of protecting herself, they agreed to let her join their quest.

Their journey carried them through a dense forest, and as night was about to fall, Cassandra noticed that a fawn lay on the side of their path, struck by the bow of a hunter. She rushed to him at once, and saw that he was dying — he had lost blood and seemed to have not eaten in days.

Bhat was struck by the plight of the fawn. At once, he muttered an incantation, and the arrow slowly pulled itself out of the fawn's leg. Then he said, "I have just the potion to save him, but I require the stem of aconite, and my stores are empty of those!" At once, Cassandra looked around, and with her knowledge of different plants and fungi, identified the right flower growing in the underbrush nearby. Bhat brewed his potion, and gently poured it into the fawn's mouth. At once, his breath slowed, and his skin healed and became fuller… he blinked, opened his eyes, and moaned with hunger.

And with a wave of his wand, Han summoned a mixture of berries from the surrounding bushes, which he gently fed to the fawn. Then, he conjured a tent and a stew, for him and his friends to spend the night. They ate his excellent brew, then each fell asleep.

As morning came, they awoke to see the fawn walking about, recovered fully. But there was an anxious look in his eyes. He sought his mother. Recognizing this, Shravan told the others to wait, and he vanished into the forest, searching high and low for the fawn's mother. Hours later, in the late afternoon, he returned, covered in grime, with a beautiful doe in tow. As soon as the fawn saw her, he leapt with joy, reunited with his ma at last.

So the group of friends bade them farewell, and marched onward and out of the forest, in search of the Cave of Wonder. And at last, at the bottom of a steep valley that had once been a river, they found the entrance to a cave, unmarked, but with an unmistakable aura of magic. Awed, they walked in, and were immediately greeted by a beautiful piece of reflective glass, embedded in the stone. From a distance, the glass shone brightly despite the darkness of the cave, yet showed nothing. But as they came closer to the glass, each of them gasped.

Shravan spoke first. "I see… I see my hometown! Alive and whole, just as it was in my childhood… and that's my home… and… my mother! Oh, Mother, there you are! I have yearned for you all those years, and you were here all along, awaiting me in this cave!"

Then Han said, "Oh, but I see my home! My shop and livelihood, and there I am, making wealth and prospering! And there is that despot who robbed me, sacked and hung for his treason to the great empire! To see this, to know that I can have it all back… I am overjoyed!"

Finally, Bhat said, "My ship… there is my beautiful ship, sailing majestically through the seas once more, her Captain, and all of our mates with us… and there I am, first mate! An honor beyond my wildest dreams! And there it lies, right there, within my grasp… finally, I can voyage the seas once more!"

Cassandra stood silent, transfixed at her mirror-self, who, unlike her, was not in shock, but smiling. The Cassandra in the mirror raised her hand, and in it — a magic wand! And as she

waved the wand about, Cassandra stood outside the mirror, seeing her reflection perform all kinds of magic: healing, levitating, potioneering… it seemed there was no limit to her capabilities. And then, the Cassandra in the mirror put out her hand, and offered her the wand! It felt so close… Cassandra could almost reach out her hands and take it… but as she reached out, all her hands touched was solid glass. This reflection, it seemed so real, and yet… how?

Years of learning and study had told her that it was impossible for her to gain magic. Did this mirror have something to offer that the most learned of scholars did not?

And then, Cassandra realized. It was a mirror. It held no reality. It only reflected what it saw inside her. It could not possibly hold what it promised. Disappointed, she pulled her hand back, and turned to look at her friends.

They were in a frenzy. Each having fallen for the charm of the mirror, they were locked in a three-way duel, intent on taking the magical glass for themselves, hoping to pull their wishes out of it.

"Will you stop a man from meeting his mother, from returning home? Are you so heartless?" Shravan yelled.

"Will you deny me my livelihood, the trade I worked so hard to build? Do you have no shame?" Han cried.

"Will you have me abandon my passion, my desire to explore the seas? Have you stooped so low?" Bhat shouted.

Cassandra saw these generous, kind-hearted young men, who had come to the aid of the needy so often before, lash out so viciously and selfishly. She could not bear it. She stepped between them, screaming for them to stop, to come to their senses. However, a curse shot out from one of their wands and blasted her out of the cave. Thankfully unharmed, she got up and ran to the cave, only in time to see it collapse onto her friends, burying them alive.

She fell to the ground, sobbing over her loss, when her teary eyes noticed a sheen on the ground next to her. It was the mirror! It had fallen out of the cave, and by some deep magic, was completely untouched by the avalanche that had taken her friends.

She picked up the heavy slate of glass, and carried it to a nearby village, from where she had it transported to her hometown, always under wraps, so nobody else may be bewitched by it. Once at her cottage, she crafted a beautiful, sturdy frame to hold the mirror, and on the frame, she wrote in runes, the stories of the brave heroes, Shravan, Han, and Bhat, and the tragedy of their demise. Then finally, at the crown of the mirror, she wrote a warning, for all those who looked in its depths. A warning that she hoped would save another brave soul from what misery befell her friends.

She wrote, "I show you not your face, but your heart's desire."

tendstofortytwo

Find an author's note here: https://docs.google.com/document/d/10UFkNIfzR2Qf16fmcGn5UWroBufSl94J_6pOVlZ_QPs/edit

A SHITTY MOVIE IDEA

Welcome back to our recurring segment, "god ⚡peED tries to write an article during layout to fill space instead of writing his articles at production night like a normal person." I'm workshopping that name.

In today's edition, we look at a shitty movie idea from yours truly. I've had a version of this article sitting around on the Wordpress, waiting for the day when I would expand it into a full-fledged article.

We don't achieve all of our dreams, dear readers.

EXPRESS

This idea came to me while I was sitting on a bus. I had also just watched Non-Stop, a Liam Neeson movie where he plays basically the same character he always plays, but on a plane. The premise is similarly transport-themed: In a dystopian future where only the rich can afford to drive, it is permitted to commit any crime, including murder, to secure a place on the overcrowded buses. Our plucky, working-class hero has to renew his ID, and so has to brave a cross-town bus trip to City Hall.

In the course of his journey, the hero must fight off his fellow passengers, likely with lots of people being thrown through bus windows. Also with those fire axes they have on trains, but on a bus.

In the climactic scene, the hero rallies the (still-living) bus passengers to rise up against the tyrannical system. However, the government attempts to stop them by sending two police buses, which pull up alongside the hero's bus and cut off the sides. A three-lane bus fight for freedom ensues. Eventually, the hero and the citizens they had befriended would fend off the policemen, and they would crash the bus into City Hall, where they would dismount it and give their speech inciting the people to rise up.

Of course, there were also potential problems. I never quite worked out why people would immediately jump to killing each other on the buses. If I want to write this movie, I'll need to get back on the GRT. You know, get in the right frame of mind.

god ⚡peED

GRIDWORD

TIME FOR A FLASHBACK

gridCOMMENT *146.4*

You may have noticed we've been a little spotty with the **gridWORD** this term. To those readers who breathlessly flip (or I guess scroll) to the back of the issue looking for a crossword, we apologize.

In lieu of a freshly created **gridWORD** this issue, we present instead the time-honored technique of creativity starved TV shows everywhere: rehashing past work.

This **gridWORD** comes courtesy of **mathNEWS** 138.1, aka the first issue of Fall 2018, aka my first term at Waterloo.

This would be a great opening to a story about my first production night at **mathNEWS**, except for the inconvenient fact that I didn't show up until Winter 2018. Also, my first production night consisted of me silently writing one article, too intimidated to join a conversation.

At the very least, I've started talking more.

Anyways, enjoy the **gridWORD**!

god ⚡ *pe*ED

ACROSS

1. E.g. shell, bubble, cycle
5. River near Ulm
10. Another example of 1A
14. Heed
15. African antelope
16. Math prize name
17. Eagle + Horse
19. Hummus holder
20. Took off like a rabbit
21. Lathers
23. Elephant-goad
26. American ___
27. Superlative ending
28. Crows
29. Cosmic radiator
31. Famous Canadian hockey player
32. English
34. Failed music service
37. Cat sound
40. R to Samsung Galaxy
41. Presentation component
42. Swiss city on the Rhine
43. Tower site
45. Smoke
46. This upgrades to a mercenary in Dominion
48. Sterotypically evil feature
51. A vector
53. Aquarium denizen
54. Man + horse
55. Outdoor stone seating
57. Casual attire
58. Hokkaido native
59. Camelot feature
64. Yuletime drinks
65. Tracked by NORAD
66. Indian bread
67. Censor's target
68. Lock
69. Found on 57D

DOWN

1. Trig. mnemonic
2. It's a wrap
3. Gym unit
4. Feverish malady
5. Niantic's *other* game
6. Instruments traditionally made of turtle shells
7. Deposited
8. Helps 65A
9. Basket material
10. Family head
11. Roman's incidental remarks
12. Used when short on spirit?
13. Great time
18. Brewer's kiln
22. Staff symbols
23. E.g. fat man
24. Water Ferris wheel
25. Last issue's theme + Human
26. Wine bottle bottoms
29. Dragon + antlers + hooves
30. Afflict
33. Student
35. It may be bid
36. 1960 Nobel Prize laureate
38. Done, for Donne
39. Sore spot
44. MathSoc is supposed to send these out ahead of their general meetings
47. The real Citizen Kane
49. "Don't bet ___!"
50. Souls
51. Edible seeds
52. E.g. φ -> (ψ -> ψ)
54. Some change
56. ___ bunny
57. Arrakis
60. Sounds like 31A
61. Sheep sound
62. ___ party
63. Eliminate

SUN JULY 4	MON JULY 5	TUE JULY 6	WED JULY 7	THU JULY 8	FRI JULY 9	SAT JULY 10
	Course selection for new students starts (new students, come to prod night)		Sliced bread is sold for the first time, in 1928			Nikola Tesla's birthday

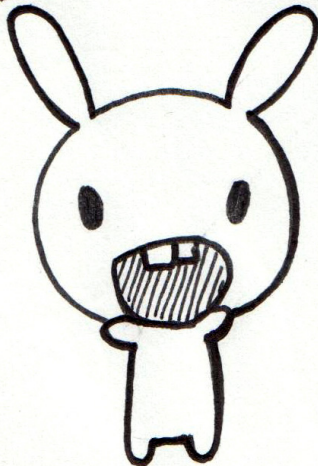| SUN JULY 11	MON JULY 12	TUE JULY 13	WED JULY 14	THU JULY 15	FRI JULY 16	SAT JULY 18
	mathNEWS 146.5 production night Course selection for new students ends			WaterlooWorks continuous postings start	**mathNEWS** 146.5 released	

CONTRIBUTE!

Send articles to mathnews @ gmail.com .

THIS ISSUE'S gridSOLUTION

S	O	R	T	■	I	L	L	E	R	■	C	O	M	B
O	B	E	Y	■	N	Y	A	L	A	■	A	B	E	L
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E	X	E	D	R	A	■	D	E	N	I	M	■	■	
A	I	N	U	■	R	O	U	N	D	T	A	B	L	E
N	O	G	S	■	S	A	N	T	A	■	N	A	A	N
S	M	U	T	■	T	R	E	S	S	■	S	A	N	D

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

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