



20
22

“WHAT TOPIC ARE YOU INTERESTED IN LEARNING MORE ABOUT?”

Good evening, my most beloved reader!

I call this an evening and not a generic time of day because as I type this, the clock on the **mathNEWS** editing PC ticks alarmingly close to 10PM, and I am reminded that while I would absolutely love to spend a few more hours in this delightfully ventilated, spacious room, the last bus home does leave in around an hour or so. Oh boy.

Anyway, enough about me, more about **mathNEWS**! As regulations start to return to What Used To Be Normal once again, we were able to organize our first in-person production night of this term! Sadly, I was not able to attend, but I have heard a great many things about a writers' union coming together to withhold articles until production nights have pizza again. To the brave writers who dare to rise up against establishment like this:

1. I see you, I hear you, and I support you.
2. Please try to resolve your issues with management rather than resorting to drastic measures.

With that out of the way, I'm happy to report that this fortnight's issue is just as great of a read as ever. I would tell you more, but I really don't want to spoil it for you. So turn the pages and read forth! Glory awaits, reader!

caffeinatED
Editor, **mathNEWS**

ARTICLE OF THE ISSUE

It's my pleasure to announce that this issue's Article of the Issue goes to *gems*, by mathEW and DARCY! The narrative, the ending twist — what more could you want?

Your prize is one (1) \$25 gift card to Conestoga Mall. Come on by to MC 3030 to pick it up!

clarified
Editor, **mathNEWS**

TOKYOCATBOY	はい。
PREDAP	So hard to choose! Maybe some more history, it's a pretty broad topic admittedly but it's so engaging!
TENDSTOFORTYTWO	Why there are markedly fewer geese on campus this term than in previous winter terms.
別	All of them
BOLDBLAZER	Yes
X	How to sing
SKIT	Anything. As long as I can have hyper-specific knowledge on something and can get popular on it.
FINCHEY	Nothing. I already have the sum of all human knowledge, right here *gestures towards genitals*
h	ISO 32000-2:2020 Portable Document Format v2.0 specification and its relation to pdfinling's \pdfliteral macro.
VINCENT	Rhetoric
WINK WONK	What the dog doin
A COOL PEN NAME	How to break into the Royal Mint of Spain, take 67 people hostage, and escape the National Police Corps with 984 million euros.
MATHEW	you. 🐼
ETERNALLY PUZZLED	Why my food goes bad faster in waterloo than in my hometown
DERIVING FOR DICK	Dismantling society
JEFF	odr-use and std::function
Xx_420SONICFAN69_XX	Gran Colombia in its cause for formation, its conquest, and subsequent collapse
someBODY	How to pass the sex midterm
APHF	your mom 😊
CAFFEINATED	New ways of brewing coffee.
CLARIFIED	Not a topic, but I kind of want to get into birdwatching.
TERRIFIED	Finchey
GOD ⚡PEED	Graphic design would be cool, I'd like to move beyond "proficient meme creator" tier.
BIPED	Logic puzzles. I'd like to bring back the haltingPROBLEM section, but before that I need to get good at making puzzles, and before that I need to get good at solving them!
REAL mathNEWS WRITER	The theory and practice of maintaining authoritarian rule in the face of overwhelming lack of pizza

It is a known fact that union dues cost exactly the amount of money it takes to buy pizza for one person.

NAMAN SOOD, **mathNEWS** EDITOR FOR WINTER 2022
ALONG WITH CHEN CHAI, TERRY CHEN, CLARA XI, AND YANG ZHONG

mathASKS 148.4

FEATURING PROFESSOR JONATHAN BUSS

TENDSTOFORTYTWO: DO YOU BELIEVE IN THE AXIOM OF CHOICE?

No. On the other hand, I don't disbelieve in it, either.

I find it somewhat like the number one: useful at times, not useful at other times.

TERRIFIED: WOULD YOU RATHER HAVE A PHYSICAL TURING MACHINE WITH INFINITE TAPE, OR AN INFINITE NUMBER OF PHYSICAL TURING MACHINES WITH FINITE TAPE?

Hmm. I don't expect to ever use up an infinite amount of anything.

The machines I have used to date (this one I'm typing on, for example) have had finite tape. Occasionally that poses a problem, especially if I don't reboot often enough. On the other hand, I have thus far always been able to get another machine when I needed one.

Perhaps that means that I have chosen the second option.

CLARIFIED: HOW MUCH OF WHAT YOU DO WOULD YOU CONSIDER "MATHEMATICS"? IS THERE A CLEAR DELINEATION BETWEEN "COMPUTER SCIENCE" AND "MATHEMATICS"?

There is no delineation between the two. Much of mathematics, but not all, is computer science, and much of computer science, but not all, is mathematics. All of my research work has been both.

TENDSTOFORTYTWO: ONE OF YOUR RESEARCH PUBLICATIONS TALKS ABOUT PALINDROME RECOGNITION ON A MULTIDIMENSIONAL TAPE. I KNOW IT'S MEANT TO BE ABSTRACT, BUT ARE THERE ANY PRACTICAL SYSTEMS YOU'RE AWARE OF THAT COULD BE MODELLED AS A MULTI-DIMENSIONAL TAPE (OR SOMETHING CLOSE)?

Physical hardware exists in three dimensions—or basically two, in current chips. The usual model of “random-access memory” is not actually the reality. An access to a “run-time heap” (as in Java) or an “associative memory” (as in Python) requires more time than the actual computation involved.

A 2D (or 3D) tape, however, isn't quite right. A Turing-style machine (a.k.a., a von Neumann architecture) has a single centre of activity, unlike a computer chip. Perhaps the best model in principle would be a 2D cellular automaton.

(It has been argued that one could improve things by building and running machines very close to the event horizon of a black hole, where space has hyperbolic geometry. In principle, one could implement random-access memory in such an environment. Escaping with the result, however, might pose a problem...)

DERIVING FOR DICK: WHAT WAS YOUR FAVOURITE PUBLICATION WITH T. ISLAM AND WHY?

Probably the one in SIGACT News. It focused not on the math per se, but rather on the ideas—on making things simple and indeed “obvious.” Regretfully, my colleagues didn't pick up on it; the paper has been largely ignored.

CLARIFIED: WHAT GOT YOU INTO YOUR RESEARCH FIELD, COMPUTATIONAL COMPLEXITY, IN THE FIRST PLACE?

It was a gradual process. One key influence was a professor I took a course from during my first year of graduate school, Michael Sipser (at the time a new assistant professor; he later became Dean of Engineering). He had such a clear way of getting at the heart of a matter.

TERRIFIED: IF YOU COULD RENAME THE BUSY BEAVER FUNCTION, WHAT WOULD YOU RENAME IT TO?

Probably something boring, such as Rado's Function.

TENDSTOFORTYTWO: SINCE YOU TEACH CS 365 SOMETIMES: WOULD YOU HAVE ANY ADVICE FOR SOMEONE LOOKING TO EXPLORE CS 365 CONTENT WHO IS UNABLE TO TAKE THE COURSE OTHERWISE (ASSUMING THEY TAKE CS 360 INSTEAD)?

One good starting point is Sipser's “Intro to Theory of Computation,” which I have used as the textbook for 365. (Get the second or third edition.) Someone with the aptitude and interest to take CS 365 should have no trouble working through it. (Effort, yes; trouble, no.) Papadimitriou's “Computational Complexity” is also good.

Another approach is simply to poke around. Wikipedia generally has good information on mathematical subjects, including computational complexity. It contains opinions and errors, of course, but the same is true of textbooks.

As you explore, do not be afraid to look up original source papers. Many of them are quite readable—especially the earlier ones, which had to explain themselves to colleagues who had never seen such material before. (Some papers are indeed rather difficult, but you can at least check them out.)

CC: WHAT'S YOUR FAVOURITE THING ABOUT TEACHING?

I get to talk about wonderful ideas.

DERIVING FOR DICK: WHAT IS YOUR FAVOURITE BUS ROUTE?

The 202 iXpress. It takes me home! Although I may have to change allegiances, now that the new bus station has opened across the Ring Road from the Davis Centre. The 201 iXpress gets just as close...

SKIT: WHAT'S THE FUNNIEST STORY YOU HAVE BUT NEVER GOT TO TELL?

Way, way back, in a previous millennium, I worked as a part-time programmer for a software consulting company whose major client was a producer of video games. One of my colleagues there had nearly finished coding his game when the word came down from above: they wanted a new title for it. He noticed that the new title had two more characters than the former one. His immediate response: "What game feature do they want me to remove?"

As it happened, his was one of the newer, larger games, whose memory chip had 4K bytes rather than the 2K bytes of the company's first games. He actually found two bytes he could do without, leaving one spare in case of later emergency.

ANONYMOUS: WHAT IS YOUR RELATIONSHIP WITH SAM BUSS, AUTHOR OF BUSSPROOFS.STY? I HEAR YOU'RE FAMILY!

He's my older brother, and also a professor, at UC San Diego. Occasionally, we get confused with one another. One source of confusion is that the result sometimes called "Buss's algorithm" first appeared in print in a paper authored by Buss (and a co-author). The paper makes it clear that the two are different people—but who reads a paper that carefully?

SQRT(CAUSE): GIVEN YOUR OBVIOUS NASCENT EXPERIENCE, WHY DON'T YOU TEACH CS 452/652?

Hmm. I seem to be missing something. What's my connection with Real Time?

Perhaps the question has a typo, and meant CS 442/642. The answer there is that Prabhakar Ragde beat me to it.

BOLDBLAZER: IT SAYS THAT YOU'VE BEEN TO ANOTHER UW. WAS THERE ANYTHING OF NOTE THAT ONE UW HAD BETTER THAN THE OTHER UW?

Well, Udub has a large mural of a Turing machine in a stairwell. On the other hand, U(W) has a number line in a stairwell. I'd say there's not much to choose between them.

DERIVING FOR DICK: HOW DOES "MIT OF THE NORTH" COMPARE TO MIT OF THE SOUTH?

When I was at Caltech, we referred to MIT as "the Caltech of the East."

To answer the question, however: each has its own qualities. Since I've known one of them only as a graduate student and one only as a faculty member, I can't meaningfully compare them. After I factor out the differences in my perspective, there's not much left.

Caltech is perhaps the "odd one out." At any one time, it has only about 800 total undergraduate students, and a similar number of graduate students.

LOLOOLOL: WHICH IS YOUR FAVOURITE BUILDING ON CAMPUS?

I like the open parts of the Davis Centre.

LOLOOLOL: ARE WE LIVING IN THE MATRIX?

I haven't a clue. Perhaps if I'd actually seen the movie, I'd do better.

CAFFEINATED: DO YOU CONSUME COFFEE? IF SO, HOW DO YOU LIKE IT PREPARED? IF NOT, WHAT IS THE BEVERAGE OF YOUR CHOICE?

I take it with cream. Sometimes, however, I eschew coffee and have stout instead.

Coffee, by the way, works differently in Canada and in the U.S.A. If your GPS fails, go into a coffee shop and request a "regular coffee." If the server asks, "What size do you want?", then you're in Canada. If the server asks, "What do you want in it?", then you're in the U.S.A. Either way, the other question has already been answered by the word "regular."

ME: COKE ZERO OR PEPSI ZERO?

No. I am one of the minority of people for whom aspartame has a distinctive flavour, completely unlike sugar. I find it rather off-putting.

CIX: WHAT DO YOU LIKE TO DO TO UNWIND AND RELAX?

Naps work well. Listening to Bach does, too. When the going gets tough, I combine them.

ABALD MAN: DO YOU HAVE ANY INTERESTING STORIES ABOUT BUSES?

Did you hear the one about the two bussers bussing on a bus? No? Me neither.

I don't want to get too deep into this, so I'll state it as a conjecture... and as a corollary, $P \neq NP$.

PROF. JONATHAN BUSS

WHAT YOUR MATHSOC VPA IS DOING: PART 4

Hello! My name is Vincent, and this term I am your MathSoc Vice President, Academic.

I plan to update students in **mathNEWS** every issue about what I've been doing at MathSoc to improve the undergraduate experience in the Faculty.

So here's the highlights since last issue.

PROCTORU

Continuing discussions about the use of ProctorU in the online sections of STAT 230 and STAT 231 this term. If you are in either of these courses and experiences issues with your midterm, please send me an email at vpa@mathsoc.uwaterloo.ca. The more details the better.

TINCUBATE-GATE

I am working with WUSA, EngSoc, and CEE to respond to the incident where an employee of the company Tincubate made fun of student résumés on TikTok. Nothing concrete yet since this incident just occurred, but the initial direction we are considering is pushing for CEE to publish (anonymized) disciplinary actions taken against WaterlooWorks employees for violating co-op rules. This will allow student to better hold the school accountable. I hope to have more to share next issue.

PD AND WORK TERM REPORTS

I will be meeting with the Associate Dean, Cooperative Education soon to discuss PD and work term reports. MathSoc's stance is that these requirements should be reduced as much as possible, and we are flexible in how to get there. Currently, the Faculty's plan is to have (most) PD final assignments count as work term reports. I will advocate to the Faculty to make sure they implement this. This should not impact the total workload of PD courses, but will instead shift the work around. So you will spend the same total amount of time on PD as you currently do each term, but maybe the first assignments will be shorter and the final assignment will be longer. However if this goes through, you will no longer have to do work term reports. Tentatively, we expect this to be in place for next term. I also hope to convince the Faculty to reduce the number of PD courses further that they currently plan.

Vincent Macri
Winter 2022 MathSoc Vice President, Academic



SHIT, I'VE DONE IT AGAIN

I've fallen into Dicksand.

Dick-sand
/'dik,sand/

Like quicksand¹, but with dicks². When a woman loses herself into a guy and in love with being in love³.

So I have this bad habit of losing at least two friends when I fall in love with a guy. I'm not sure if it's conscious or willful. Maybe it is. I'm not sure if believing either makes me feel any better about myself despite my actions being entirely what can only be described as “asshole-ish.”

I'll fall in love with a guy and little by little my priorities change. I lose touch with friends. I make too many sacrifices. I stop attending club meets and university events. I stop exercising and taking care of my body.

But it's not as if all my energy becomes focused on my significant other. That's not really the way it happens. Rather, it's as though seeing friends and helping clubs brings me joy like weed—and I am usually happy taking a little marijuana now and again, and it doesn't go any farther. Then I meet *the one*, and it's like trying cocaine (to be clear, I've never tried drugs and don't know what that's like so please don't do drugs to confirm any statements in this article).

This is a very 15 year old girl feeling to discover. To be clear, I've fallen into Dicksand at 15 too. And 16. And 17 and 18 and now 19. No offense to the guys, it's not their fault; I'm just exasperated at my inability to be a complete whole individual when I'm a part of a pair. And the obvious solution is to change my attitude, to be more enthusiastic when spending time with my friends and other parts of my life. But the cocaine is just too good! And why shouldn't I spend the most time possible doing what makes me the most happy?? Oh right, short term pleasure over long term gains.

I'm not very happy with this article right now. It captures the worst parts of myself when I'm in a relationship, when I'd obviously rather focus on the great parts instead. Maybe writing this crappy article about being immature in love is a bit of a promise for me to do better, like one of those fitness instagram posts a person shares after New Year's. Oh well, here goes nothing.

Young and stupid

1. <https://www.urbandictionary.com/define.php?term=quicksand>
2. <https://www.urbandictionary.com/define.php?term=dicks>
3. <https://www.urbandictionary.com/define.php?term=being%20in%20love>

FUCK IT, I'M WRITING MY OWN C++ ARTICLE

Do you love reading articles about programming but hate learning new things? Well, you're in luck! I've finally had enough of this so called "jeff" (if that's even his real name) and his constant gloating of his C++ skills. I'm sure I would be a C++ expert too if I had any ability to recall class material from longer than 20 minutes ago. So to prove my programming skills are superior, I asked Evan — a known C++ enthusiast and non-mathNEWS writer, to come up with some questions for me to answer in order to finally dethrone my long-time nemesis jeff. As C++ programmers always say, let's malloc right to business.

HOW DO YOU COMPUTE X! IN COMPILE TIME?

That was a hard question to start with, mostly because I had no idea what the concept of compile time meant. (Who even uses a compiler these days? Just learn Python, where the code just magically turns to assembly and you don't have to waste precious brain cells wondering how.) After a brief explanation, I've been told compile-time means that the compiler must know the value of $x!$ right as the value of x is declared. Therefore, the compiler can't wait to compute the factorial of x with a traditional function. Remember, this explanation has been approved by me, a C++ expert, so feel free to cite it in your next assignment / interview / letter of resignation from the faculty. Since the question basically boils down to computing a function without the time complexity of actually computing the function, my intuitive approach to solve this problem would be this:

- Get the time machine from the movie *Tenet*.
- Use it to solve all programming questions before they get written.
- Get the solution to $P=NP$ from the future.
- Realize that you still don't really understand what $P=NP$ is all about and have no idea what the solution means.
- ???
- Profit.

IMPLEMENT A COMPILE TIME RACKET INTERPRETER IN C++.

Why don't you interpret yourself some bitches in compile time.

IMPLEMENT `STD::TUPLE STD::GET<N>`.

Despite the fact I totally understood what this question asked me to do, I'll just quickly take the time to explain what it means to less experienced mathNEWS readers who have somehow stuck through this article. An N -tuple is a collection of N values bunched together, and the `get-<N>` function would return the N th element in the tuple. A foolish mistake which I totally didn't personally make is to think that a tuple only meant a collection of two items. Apparently, and again — I totally knew this, a tuple of two elements is called an `std::pair`. So to answer the original question, suck my `std::pair<Ball>`.

IMPLEMENT AN RPG PLAYABLE IN GCC WITH MAKE.

You got it:

- Make install World of Warcraft
- Make init World of Warcraft

And if you really want to spice things up and improve your gameplay:

- Make touch grass

WHAT IS THE VALUE CATEGORY OF `STD::MOVE(X)`?

Completely worthless.

GIVE AN EXAMPLE OF AN LVALUE.

The massive L I would be taking by knowing any C++.

WHAT IS A MEMORY LEAK AND HOW DO YOU PREVENT IT?

Oh, I'm definitely an expert on memory leaks. Like I mentioned before, I can't remember a single damn thing from CS 246, so clearly I've been dealing with and resolving memory leaks for a while. Wait, did I mention the memory thing before? And who keeps putting all these articles on my mathNEWS writer account?? And why does that bastard keep leaving notes like "Remember, you have Alzheimer's" all over my room?? One day I'll catch him...

Anyways, memory leaks happen when your code is so shitty it drips out of your RAM sticks and through your computer, leaving your keyboard covered in what is referred to as Gamer Juice™. One way to lessen its effects would be to periodically download more RAM through my trusted website methNEWS.com/viruses/RAM-download and write down your credit card details in the form. This will ensure that no matter how many memory leaks you have, I get to buy myself a vacation to Mexico you'll have enough RAM to sustain your computer. If you want to completely prevent memory leaks, cover your computer in something that is completely leak proof, like the condom you got from orientation. Let's be honest — you just finished reading a mathNEWS article about C++, you weren't going to use the condom anyways.

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N STUPID THINGS TO DO WITH A LIST

- Write one

someBODY

LA INTERNACIA LINGVO

La internacia lingvo, or la internacia for short, is the original name for a language known today as Esperanto. Perhaps you have heard of it, perhaps not. I would like to tell you a bit about it.

Esperanto is a constructed language; it was created by Zamenhof and introduced to the world in 1887. It is the most popular constructed language in the world. It is not easy to get a proper estimate of the number of Esperanto speakers in the world, but I have heard numbers from 100,000 to 2 million, as well as a thousand or more first language speakers. The Esperanto Wikipedia has over 300,000 articles, which is more than, for example, the Greek Wikipedia.

Since Esperanto is a constructed language, its grammar is incredibly simple, and there are usually no exceptions at all to any grammatical rule. There are no irregular verbs. In addition, according to the Akademio de Esperanto (akademio-de-esperanto.org), there are under 6000 root words. Other words in the language are created by adding affixes (of which there are about 50) to existing roots or by forming compound words. This significantly reduces the amount of memorization needed to become fluent in the language. In addition, the alphabet is almost perfectly phonetic, with the only exception being the 6 diphthongs, where two letters combine to form a sort of compound vowel. These diphthongs are aj, ej, oj, uj, aŭ, and eŭ. The first one is pronounced like the word *eye*. The language is so phonetic that the n, g, and v in the word *lingvo* are all pronounced separately. And the k and n in *knabo* are both pronounced as well. If you know how to pronounce a word in Esperanto, you automatically know how to spell it.

The simplicity of Esperanto's alphabet, vocabulary, and grammar make it very easy to learn, especially if you happen to already know a language like English, French, German, Russian, or Italian. I know this from experience: I started learning Esperanto in early 2020, only spending a little bit of time on it each day, and in less than a year I was advanced enough to read an Esperanto translation of *The Hobbit* without too much difficulty.

Because it is relatively easy to learn, Esperanto is the language which would take humanity the least amount of collective effort to turn into an international language. Well, probably not, since there are other constructed languages and one of them is probably even easier to learn than Esperanto, but Esperanto is definitely better in this respect than English, Mandarin, or any other irregular natural language. Even though many more people in the world know or are learning English than Esperanto, English is really hard to learn. Also, it is much less fair for a language like English to become an international language, since there are already many native English speakers. However, Esperanto is not entirely fair itself, since it is heavily based on European languages and is therefore, at least in theory, easier to learn if you grew up speaking a European language.

Originally, Esperanto was created to become the international language. It was not intended to replace other languages, but rather to be everyone's second language. *La internacia lingvo* literally means *the international language*. For a time, it even looked like Esperanto might actually achieve this goal. It almost became the language of the League of Nations after World War One. Only one delegate opposed its adoption.

Unfortunately for Esperanto, Hitler came along. You see, Zamenhof was Jewish, so Hitler made Esperanto illegal in Germany after he took power. Esperanto speakers were some of the many people put into concentration camps and killed during the Holocaust.

I personally think that it would be great if everyone in the world knew Esperanto as a second language. Imagine being able to go to any country and automatically share a language with the people there.

If this article interested you, then you should learn Esperanto (note how I did not say if and only if). Again, it is very easy to learn. You can learn it using Lernu! (lernu.net), on Duolingo (duolingo.com), by finding one of many PDF files available on the internet which teach Esperanto, by getting a book on it, or by finding an Esperanto speaker willing to teach you. Even if you would rather learn some other language, I encourage you to learn Esperanto first: it will take much less time and can help you prepare to learn a different, much harder, language.

I will leave you with a classic Esperanto joke which relies on its affix system and therefore cannot be translated into English: *kial la ĝirafo neniam estas sola? Ĉar ĝi havas kolegon.*

$((\lambda(* /)(** /))(\lambda(+ -)(if - -(+ + \#t)))\#f)$

AN ACADEMIC RESPONSE TO "DID EPSTEIN KILL HIMSELF?" FROM mathNEWS 148.3 BY BOLDBLAZER

Thomas Bach hardly became the Olympic champion in fencing; his gold medal is from the team foil event. At best he is one of 5 Olympic champions if you only count team foil. At worst, he is one of 24 Olympic fencing champions. But don't let that distract you from the fact that Albert II, the current prince of Monaco, competed in bobsled at 5 different Olympics.

methNEWS REVIEWS: GOING TO A CLUB

I've been proudly lurking on the **mathNEWS** discord for a while, and a couple weeks ago I noticed a conversation between some of our acclaimed writers discussing what going to a club is like. As something of a ~~functioning alcoholic~~ studied expert myself, I thought I would take matters into my own hands and write an investigative piece reviewing Waterloo's finest club (in terms of proximity to my apartment). And just a quick note before we get to the main part of the article: I don't mean for this review to sound condescending, as if I think I'm better than everyone because I go to clubs. I mean, I definitely think I'm better than everyone. But that's mostly because of my sick rapping skills and not because of my slight advantage at handling ethanol in crowded and loud environments.

After discussing our club options, my friends and I decided to try out Phil's. This article isn't sponsored by Phil's in any way, but if you ever check it out feel free to use coupon code "**methNEWS**" for 10% off your next regretful memory. Clubs usually open at about 10 PM, with lines to get in starting to form around 30 minutes before opening. So naturally, we showed up at midnight after an intensive walk on the treacherous and giant ice fields that used to be called the Columbia Street pedestrian walkway.

I would definitely say going clubbing in the summer is better than in Winter, since it allows you to stand around in lines without the risk of getting hypothermia and dying steps away from an Osmow's Shawarma location. Luckily, I found out a helpful tip to pass the excruciating waiting time in the freezing weather: bonding with the people ahead of you in line! Since most clubs are located on King Street for strategic Laurier Student deployment, this could be your one chance to talk to people from other universities! Think about how much you have in common to talk about: you're both waiting in line, you both have to pee, and you both have no idea what that math program you just told them you do in Waterloo is all about.

When deciding who to go clubbing with, I realized there are basically only 2 options. Here are the pros and cons of each one:

Option 1: Go with a bunch of people who can't dance for shit.

Pro: This is the only group of mammals on this planet with whom you don't stick out as the worst dancer.

Con: Having a group of people who can't dance all moving synchronously on the club floor would make security think you're trying to summon Beelzebub.

Overall, not a bad option. Especially if you think you have enough charisma to convince a bouncer you're not a cult leader.

Option 2: Go with people who are actually good at dancing.

Pro: You can copy your friend's hard-earned dance moves that they spent so much time learning.

Con: In comparison to your talented friends, your dancing is going to look like you're experiencing an aneurysm.

I decided to stick with this option, since the ambulance I assumed they'll call for me could probably drop me off at my apartment, saving me the money on the Uber trip home.

Finally, to fully enjoy clubbing the way God/Snoop Dogg intended, it will help to be intoxicated in some way. For legal reasons, I will talk only about alcohol, but you should realize I didn't just randomly pick this pen name for nothing. A lot of people think drinks are too expensive in clubs and buying them is a waste of money, but they're all missing one essential point: the drink's price isn't high because of its quality as a product, but as a service. For example, when I ordered their feature shot called "pop my cherry" I wasn't paying \$3 for the liquor, but for the experience of being judged by everyone around me in the bar.

If you want to try clubbing but are too scared to do it, you should definitely know this: with enough practice, once you finally master these complex aspects of partying you'll be able to let yourself loose and stop overthinking everything. After that, it's just up to you and your friends to enjoy your time together. And if that doesn't sound like your thing, I would suggest cutting the obvious middle man of the night and go straight to McDonald's at 2 A.M. That's where everyone ends up anyways, and you could reduce ice in your shoes by about 50% if you just go there immediately.

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π REASONS TO CONSUME PIE ON PI DAY

- it's tradition
- why *wouldn't* you want to consume pie on Pi Day?
- if you don't, the ghosts of **mathNEWS** will haunt you
- th—

eternally puzzled



✧ ENAMOURED ✧ AND ☕ CAFFEINATED ☕ REVIEW SOME YUMMY FOOD!

Yum yum yum!!! I love ☺ eating yummy foods like breakfast sandwich!! My good friend ☺ caffeinatED ☺ and I got some yummy ☺ foods from Waterloo Central and ate them!! You should try them too! ☺

MILD-SWEET ☺ TREHALOSE BLUEBERRY ☺ AND STRAWBERRY ☺ FLAVOURED NOUGAT ☺

CHONGQING STRANGE-TASTE ☺ HORSEBEAN ☺



What the fuck... there is so much... flavour... oh God the flavour oh God maybe if I drink some nice Glucose & Salt Drink that will help... or maybe even pasta sauce at this point I'm willing to consider all options...

Crunch! They forgot to put flavour in it... It just tastes like nothing... There is a nut, and then there is the glue that is holding it together. I think I might lose teeth over this. Actually it feels like you don't have the flavour, but ten seconds later you get the flavour.

CAFFEINATED

CAFFEINATED

Tasty ☺ and crunchy!! It's sweet ☺ and salty ☺ and spicy ☺ and tastes like fruit ☺ loops ☺ and peas! Awww you little horse beans you're. So. Cute!! ☺

Kinda tough and chewy!! Oh, Nougat, you're a quiet ☺ and stubborn ☺ one aren't you... But deep down I think you have a good heart ✧

ENAMOURED

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UW'S BASTION OF ERUDITE THOUGHT SINCE 1973

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DRINK 🥤 (GLUCOSE 🧬 & SALT 🧂 FLAVOUR)



You know, when you think about glucose flavour, you imagine something... “this is what glucose tastes like”—this is exactly that. It reminds me of those energy drinks you give to kids.

CAFFEINATED

caffeinatED's right!! It's such a quirky 😊 and unique 🧬 drink!! The chemical symbols on the front make it look sooooo science-y 🧪 and smart 😊

ENAMOURED

Hope you enjoyed 🥰 enamourED 🥰 and 🥤 caffeinatED 🥤
Review Some Yummy Food!

enamourED & caffeinatED

SUPER EUROBEAT: LEETCODE IN THE DOJO

(sing to Running in the 90s from the Initial D soundtrack)

[Verse 1]

List traversing, dereferencing
Linear time, must go faster
Tree descending, child selecting
Left or right, I will master

[Pre-Chorus]

Walk the input stream, if you want a copy
Sorting everything, I want to optimize it
Get the minimum, pick it from a minheap
All I wanna get, is the answer

[Chorus]

Leetcode in the dojo
Writing code in serenity

Grinding Leetcode in the dojo
Coding for the inner peace
Hustling Leetcode in the dojo
Every malloc comes with a free
Questing Leetcode in the dojo
Am one with the code, code is one with me

[Verse 2]

Graph exploring, breadth-first searching
Path to find, graph is vaster
Sorted searching, halfway splitting
log n time, make it go faster

[Pre-Chorus]

Walk the input stream, if you want a copy
Sorting everything, I want to optimize it
Get the minimum, pick it from a minheap
All I wanna get, is the answer

[Chorus]

Leetcode in the dojo
Writing code in serenity
Grinding Leetcode in the dojo
Coding for the inner peace
Hustling Leetcode in the dojo
Every malloc comes with a free
Questing Leetcode in the dojo
Am one with the code, code is one with me

[Bridge]

Must go faster
I will master

[Chorus]

Leetcode in the dojo
Writing code in serenity
Grinding Leetcode in the dojo
Coding for the inner peace
Hustling Leetcode in the dojo
Every malloc comes with a free
Questing Leetcode in the dojo
Am one with the code, code is one with me

[Outro]

Tree descending, child selecting
Left or right, I will master
Walk the input stream
Sorting everything
Get the minimum
All I wanna get
Leetcode in the dojo [x4]

tendstofortytwo

Due to current world events, this article has been intentionally left blank.

profQUOTES

CS 146: BRAD LUSHMAN

- “ Now C has come closer to its greatest dream of being Racket.
- “ In some way, theft is just garbage collection. You don't need all that stuff anyway.
- “ I'm gonna call it used car salesman mathematics. If you are a used car salesman, I apologize.

CS 146: ROB HACKMAN

- “ I didn't do my undergrad here. I did it at a university that's actually fun.
- “ You guys are all nerds, but don't worry: I am the largest nerd here.
- “ You're getting on my nerves almost as much as Canadian airlines and telecom companies get on my nerves, which is to say a lot.
- “ *(Students clapping)* Why are you doing that?
- “ This isn't a poetry slam.
- “ Copacetic?
- “ Don't care about it, I don't care about the steps, let's simplify it.
- “ Or we can spend another three minutes... wait, we're past time already???
- “ Please don't tell the Dean I can't do math. I'll get fired.
- “ Why do people do anything? I don't know, I'm not a psychologist.
- “ *(Abbreviates set x to sex.)*
- “ Listen, I have a very fragile ego. I can't deal with Brad making fun of me too many times this term.
- “ Computer keeps falling asleep. Sometimes you just need to hit it.

MATH 114: MARINA CHUGUNOVA

- “ Eigenvector is camel in the desert, carrying whole huge structure on its back and on itself. Zero does practically nothing like that and can't carry anything. Eigenvector must be camel and not zero.

MATH 148: BLAKE MADILL

- “ And this is gonna blow your mind. Kidding! It's dreadful.
- “ You probably know the proof already, but I feel guilty if I don't show it to you.
- “ Let's do some exercise for now, and the time is *(looks at the clock)* perfect!
- “ It was one of those arts classes where if you try very hard you get an 82, and if you don't try you get an 80.

PMATH 333: DAREN CHENG

- “ My choice for writing a k here is psychological.
- “ The definition of finiteness is something we will NOT get into.
- “ *(Remark given in notes a week later)* If it really bothers you, the definition of finite sets is...
- “ This is not drawn to scale.
- “ We have to write down the function—very painful, but we'll do it.

N MATH THEMED WHITE ELEPHANT PRESENTS

- Chalk that is designed to break immediately
- The empty graph
- Whiteboard marker that only rapidly scribbles but cannot write letters
- A 3D matrix made of marshmallows and toothpicks
- Calculator that always gives you the wrong answer
- A Markov chain that's just the identity matrix
- Plane ride that makes three 90 degree turns and lands where it started
- Vacuously true statement
- Clock that works randomly
- Tautology
- 1mm ruler
- Trivial group
- Compass that draws penises instead of circles
- “The currently known lower bound for this algorithm is $\Omega(1)$ ”
- An eraser that erases pencil markings but also colours in anywhere where there wasn't pencil before
- A Turing machine that never halts but you can't prove that it never halts

MY GRANDMA'S PIE RECIPE, FOR PI DAY

If you need an excuse to stuff your whole body with pie—Pi Day, the most esteemed holiday of all mathies, is coming up. In preparations for the festivities and feasts to come, I would like to share my grandma's recipe for apple pie. It's simple, quick, and infused with the spirit of the nonexant Kingdom of Bavaria from which her ancestors hailed. (Little did you know, apples are endemic to Bavaria, which is why apple pies and strudels are considered to be such iconic, representative foods of the culture.) Don't worry if you've never made pie on your own before—it's a piece of cake. Or dare I say, *pie*?

INGREDIENTS

- 2 cups flour. This is a flexible recipe, so use any kind of flour that works best for you—all-purpose, pastry, whole wheat, corn, chickpea, dandelion, almond, petunia...
- 1 tsp baking powder. Can substitute with 1 tsp baking soda. They're the same shit anyway.
- 1 egg, beaten within an inch of its life.
- Unutterable amounts of butter. Or margarine. They're the same shit anyway.
- 1 tsp of salt carefully chipped away from a Himalayan salt lamp on display in a Canadian Tire.
- Some Caramilk bars.
- Beer. Heineken to be authentic. Sapporo if you're gunning for some fusion cuisine.
- Apples. Duh.

STEPS

1. Make the dough by mixing together the flour, baking powder, beaten egg, butter, and salt. You may do this with either an electric mixer if you want to be prissy about it, or by hand with a spatula if you're hankering for a workout.
2. Roll out the dough. You want that shit flat like that Flat Stanley motherfucker. Flat as fuck.
3. Cover the sides of a pan with the dough. Any pan that works best for you will do—sheet, frying, sauté, cast iron, non-stick...
4. Chop the apples, or leave them whole if you're going for that "apple-bobbing" feeling. Very Bavarian of you.
5. Put the chopped apples in the pan, and fill it with as much caramel as you can muster by sucking away the insides of the Caramilk chocolate bars and spitting it back, like a regurgitating hummingbird mommy. Top up with beer for colour.
6. Set the oven to 425 degrees since you forgot to do so earlier. Pre-heating's a conspiracy orchestrated by Big Power anyway. You have flexibility in what unit of temperature you use—425 Celsius if you want to get over with this quickly; 425 Fahrenheit if you want to be authentic about it.

7. Put the pan in the oven and wait for it to cook. You will simply Know when it is done. Let the wandering spirit of my grandma (who died in mysterious, pie-based circumstances—her body being found at the bottom of a well, pristine pie servers gripped in each of her white-knuckled hands) guide you. Ole grammie was never wrong.

Have a happy Pi Day, darlings!

Finchey

GEMS

i saw them.
 shining like the brightest of stars in the darkest of nights.
 alone in the dark, their brilliance tugs at me.
 between the wisping smoke and whispering strangers, i found her.
 before i knew it, i was staring. and before i knew it, she was too.
 i palpitated. never before had it been so corporeal.

she approached. i feel something ive never felt.
 fight, flight, something in between.
 i couldnt control myself. i wanted them so desperately.
 i craved them. craved to feel them.
 my body needed to be claimed. to be marked by her beauty
 she arrived before me and i arrive before her feet as my knees finally buckle

i needed to feel them, needed to have them sink into me
 those gems that make venus writhe in jealousy.
 to embrace my supple sides with grace and vigor

she opened wide.

blessing the world with another, so painfully short glimpse of the window to her core

those diamonds
 those brilliant flashes of perfection

then i see it
 my heart sinks
 in the farthest depths of her maw, a twinge of darkness shone through the brilliance of the heavenly light within
 for even the brightest of suns cannot hide even a speck of sin
 i finally realize. inside beauty is always filth
 my body knew it had lost
 there is no heaven.

i hate people who dont go the dentist.

UPCOMING CYCLE 2

~~TEMPLATE FOR EMAILS BY PD900 TAs~~

Hi [Student Name],

[first person singular subject personal pronoun] I [(transitive) To be aware of; to be cognizant of] know [second person singular object personal pronoun] you [second person singular simple present of be] are [Within the bounds or limits of] in [Definite grammatical article that implies necessarily that an entity it articulates is presupposed; something already mentioned, or completely specified later in that same sentence, or assumed already completely specified] the [A series of events which produce a result (the product)] process [Used to introduce the “subjective genitive”; following a noun to form the head of a postmodifying noun phrase] of [(transitive) To search for; to seek] looking for [(transitive) To search for; to seek] your [Preceding all others of a series or kind; the ordinal of one; earliest] first [A unit of a housing co-operative; a purchased apartment where the apartment owners collectively are responsible for maintenance of common areas and upkeep] co-op [An economic role for which a person is paid] job [Used simply to connect two noun phrases, adjectives or adverbs] and [wished for; desired; sought] wanted [(transitive) To formally announce one's arrival at a location or event (usually a hotel) to a proprietor or employee of that location or event in order to secure admission, accommodations, or other services] to check-in [To witness or observe by personal experience] to see [The manner or way in which] how [Definite grammatical article that implies necessarily that an entity it articulates is presupposed; something already mentioned, or completely specified later in that same sentence, or assumed already completely specified] the [A series of events which produce a result (the product)] process [Third person singular simple present indicative form of be] is [present participle of go] going. [simple past tense of do] Did [(object pronoun) The people spoken, or written to, as an object] you [(transitive) To perceive the truth or factuality of; to be certain of or that] know [Introducing a clause which is the subject or object of a verb (such as one involving reported speech), or which is a complement to a previous statement.] that [The third person singular personal pronoun used to refer to an inanimate object, abstract entity, or non-human living thing] it [Third person singular simple present indicative form of be] is [Forms the superlative of many adjectives] most [Occurring or happening regularly or frequently; usual] common [Directed at; intended to belong to] for [Preceding all others of a series or kind; the ordinal of one; earliest] first [Labour, occupation, job] work [A chronological limitation or restriction] term [a male (especially university) student] students [(transitive) To encounter or discover by accident; to happen upon] to find [The work or occupation for which one is used, and often paid] employment *later on in the recruitment term?* [An interval of space or time in which one set of events or phenomena is completed] Cycle [The cardinal number two] 2 [Third person singular simple present indicative form of be] is [Having traits or characteristics in common; alike, comparable] similar [Used to indicate the target or recipient of an action] to [An interval of space or time in which one set of events or

phenomena is completed] Cycle [The cardinal number one] 1 [Used simply to connect two noun phrases, adjectives or adverbs] and [(transitive, ditransitive) To transport toward somebody/somewhere] brings [(colloquial) A lot; a great deal; tons; loads] lots [Indicating removal, absence or separation, with the action indicated by a transitive verb and the quality or substance by a grammatical object] of [Recently made, or created]n new [An economic role for which a person is paid] job [A favorable circumstance or occasion] opportunities, [Used simply to connect two noun phrases, adjectives or adverbs] and [An interval of space or time in which one set of events or phenomena is completed] Cycles [The cardinal number three] 3-[The cardinal number six] 6 [To possess, own] have [One; any indefinite example of; used to denote a singular item of a group] a [To a great extent] much [comparative form of fast: more fast] faster [The act of turning to face in the other direction] turnaround!

I look forward to hearing from you about your co-op job search progress. As always, the PD900 team and I are here to [(transitive) To provide assistance to (someone or something)] help you.

[NAME] John Doe

PD900 TA

REVIEW ANNOUNCEMENT: KANYE WEST, 2016 TO PRESENT

X Presents a Review of Kanye West's Discography from 2016 to Present Reading Event 8pm Friday March 18th, 2022 Mercedes-Benz Stadium Atlanta

yye West

WINDOWS 11 REVIEW: IT BAD

Hello, and welcome to Operating Systems Review! Today, we shall be looking at the newest entry in this space from the company formerly (and currently, for that matter) known as Microsoft—Windows 11. Reviews of the new operating system have generally been mixed, but given that it isn't being shoved down people's throats the same way that Windows 10 was, there is a lot less animosity towards it overall. Which makes the mixed reviews even more interesting, since it means that people who *willingly upgraded* don't even always like it. People like me!

Firstly, some backstory—this review is coming out late because as of last issue I didn't really have a device I could run it on. The only device I had that was compatible was my laptop—which runs Fedora, as described in *Fedora 35 review: broadly alright*, and the only device I had that I used Windows on was my desktop—which, before a recent CPU upgrade, was incompatible. Thankfully, recently I got a CPU upgrade which made it compatible! Now I could experience Windows 11 in all its glory.

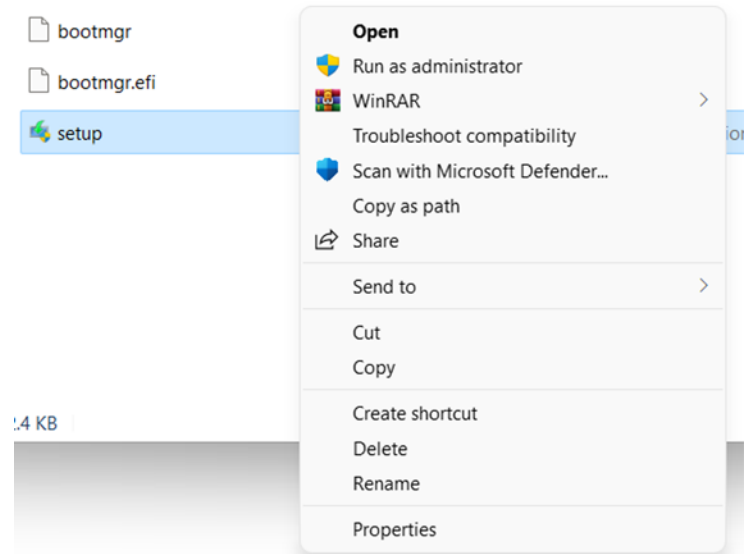
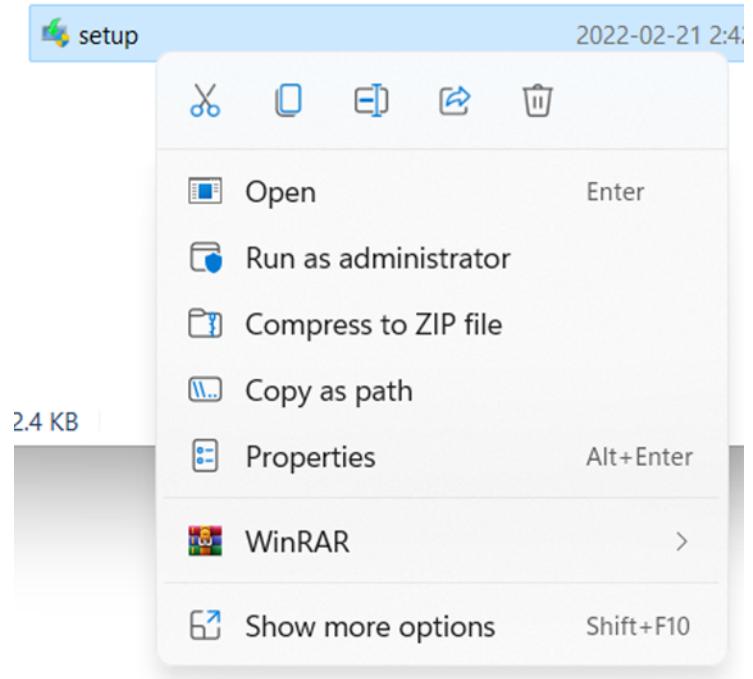
The installation process was pretty easy—the first stage is nearly identical to Windows 10, where you boot from a USB and it dumps a half-baked copy of Windows 11 onto your formatted hard drive. Then it reboots into this new copy which then completes its own baking process specific to your hardware. The issues begin after this, during first-time setup.

I got Windows 11 Education through Microsoft Azure for free¹, so this doesn't apply to me, but it turns out that anyone using Windows 11 Home (and now even Pro) cannot setup the operating system without an internet connection and a Microsoft account. What if you don't have internet? Sucks to be you, I guess. Don't have drivers in the base Windows 11 install? Sucks again. Don't have a Microsoft account and don't want one? Guess what, sucks to be you. Again, 11 Education doesn't yet have this problem (so see the footnote to get your copy today), so I didn't have to deal with this, but it's annoying that a lot of people will have to. The only problem that I dealt with is that on top of the setup being ridiculously full of dark design patterns to get you to sell your soul to Microsoft (which Windows 10 had as well), it is now also filled with superfluous animations, which are very choppy if you don't have your graphics drivers in the Windows 11 base install. Great!

After setup, you're dropped to the desktop, which is basically the same except that all the buttons in the taskbar are centred. It's only when you click around do you see how much has changed. Right-clicking on the taskbar, you notice that the large useful menu of The Old Times is gone, replaced by this ridiculous *one-item* menu.



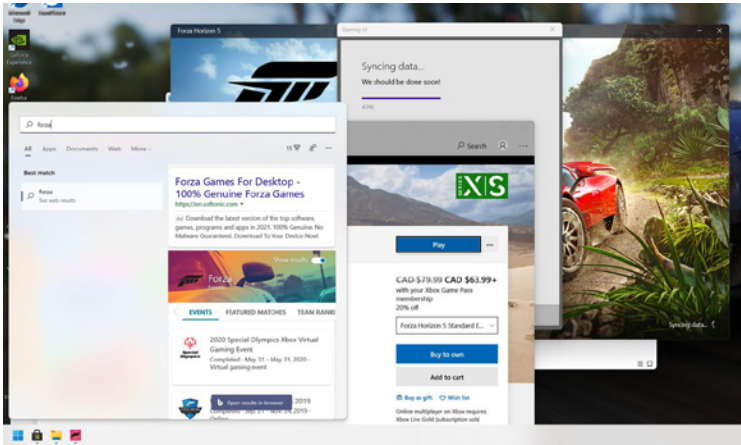
Why would you do this? Why would you take a perfectly good menu and remove options from it? I don't understand, and I'm not quite sure I ever will. Anyway, this sin is also committed in File Explorer windows, where there's a modern incomplete menu that is replaced with the old complete menu if you click "Show more options":



And no, that's not just me taking screenshots in different places—the second menu actually appears further away from where you clicked. Don't ask.

Also, Windows Search is terrible! I don't know how they keep making it worse in every release—Windows 7 was great, 8 was good too but the UI got worse, 10 was pretty bad, and 11 is just terrible. Here's a screenshot of me running Forza Horizon 5,

the Windows Store saying that Forza Horizon 5 is installed (the Play button indicates that it's ready to play), and Windows Search still cannot find the game:



It can find a bunch of malware sites though, which is always great to see as part of a first-party feature in your operating system.

Also, I don't have a picture of this, but I was overclocking my RAM and as part of that I had to reset my BIOS for a bit, and when I did that Windows lost my login PIN? Like, I still remembered my PIN, but when Windows turned on it would not let me type it in. It would just say “there's a problem with your PIN” and tell me to reset it by logging into my Microsoft account. This was especially great the first time because I hadn't setup WiFi yet and so I was literally unable to log into my Microsoft account to reset my PIN (that I still remembered) until I got my Ethernet back. So if this happens to you somewhere without internet... sucks to be you, I guess.

I would go on, but the examples above summarize my problem with Windows 11—it is nothing but Windows 10 with a fresh coat of paint that already seems to be peeling. Overall, this has been a straight downgrade for me so far. I much prefer Windows 10 to this broken, user-hostile mess. The only reason I am not going back to Windows 10 is that I did a clean install and so the only way to go back is to clean install again and then I'd have to download Forza again which is 100GB and I'm not doing that.

God, I wish I could just play Forza on Linux. Fedora is so much better.

tendstofortytwo

1. As a UW student, you can get Windows 11 (or 10) Education for free too! Education is basically like Enterprise which has all the Pro features and more. To do so, sign up here: <https://azure.microsoft.com/en-us/free/students/> And then after confirming your UW account, go to <https://portal.azure.com/> and click Explore under Access Student Benefits. Then click Software on the left bar, and pick from Windows 10/11/a bunch of other software like Visual Studio that you get for free.

N FRENCH EXPRESSIONS TRANSLATED LITERALLY

- Not an expression, but what gave me this idea: pinecone is actually “apple of pine” in French. Pine apple. Got it?
- “Go cook yourself an egg”: not sure this one is used by other people than my family, but it kinda means “go screw yourself”, in a more polite way.
- “Drowning the fish”: change the subject to avoid talking about something.
- “Disappointed in a good way”: this one is a Swiss expression, to use when you are happily surprised but you don't actually want to say that you are happy.
- “Run on the bean”: when someone runs you on the bean, they piss you off. Don't ask me why this expression is so strange. No one knows.
- “Swallow grass snakes”: it means believing anything.
- “Having the potato”: be in a great mood.
- “Put a rabbit to someone”: stood someone up. Why a rabbit? Dunno.
- “Sing like a saucepan”: mate, you are off-key.
- “Break sugar on somebody's back”: talk about somebody behind their back. Sugar should be sweet, but no, it just means that you are criticizing a helpless person.
- “Have a cat in your throat”: have a frog in your throat, a sore throat. In German it is also a frog apparently, but we French like cats better, despite what is told about frog eaters.
- “I say this, I say nothing”: equivalent to just saying..
- “Fingers in the nose”: more disgusting way to say ‘I can do it with my eyes shut’.
- “To have the ass surrounded by noodles”: be very lucky. Yeah, French is an amazing, colourful language.
- “To have the cockroach”: feel down.
- “Mind your onions”: mind your own business.
- “Be at the strawberries”: be out of the subject, lost in the conversation, this kind of mood.
- “It gives me a beautiful leg”: meaning I don't care, whatever you said is not relevant to me.
- “Wanting the butter and the butter's money”: well, it's clear enough I think, be greedy. And since I don't want the butter and the butter's money, I'll stop here (but French has many more great expressions!)

aFrenchieLostInCanada

RECALL UPCOMING CYCLE 2

John Doe would like to recall the message, [Upcoming cycle 2](#).

PD900 TA

AWESOME POINTS III

CONTINUED FROM LAST ISSUE'S AWESOME POINTS

AP LAUNCH — T + 6 DAYS

“Awesome Points providing monetary rewards to students simply for chatting is illogical,” continued Name. “Just giving out points for sending messages won't make those messages meaningful or create connections.

Josephine and Name sat face to face with each other in a small meeting room attached to Gaming Club's office. Name, the stalwart MathSoc Councillor, had barged in a few minutes ago shouting something about how Gaming Club's Awesome Points program was violating MathSoc policies. Name claimed she'd sent an email about her concerns already, but Josephine had missed it as the email had landed in her inbox only an hour earlier. She'd noticed after a quick glance at her inbox after Name's mention — it felt like a surprise attack.

“I've also heard that you've received funding from ManaCorp. As all club executives should know, MathSoc policies outline that all funding must be reported to MathSoc and deposited in the MathSoc bank account. As far as I know, MathSoc has received no report of any funding.”

How did she know about that? “Sorry, Name. I meant to get around to that yesterday, but it's just been a busy week for me.” Name's hair was in a neat top bun today, and Josephine couldn't help but admire her composed look. Josephine wore an okay-fitting *Carnage of Glory* sweater, and big round glasses she'd always worried were too nerdy on her Asian features. Her hair was down and a little ruffled.

“In conclusion, Vice President, I'm giving you the chance to shut down the Awesome Points program before I'm forced to take the matter to Council.” Name's voice suddenly turned softer, and her eyes filled with compassion. “Josephine, I don't want Gaming Club to get in trouble. I just want to help.” Josephine didn't believe it for a moment.

“Thanks for sharing your concerns, Councillor Person. I'll get back to you shortly.”



#GAMING-CLUB-EXECS

Josephine (VP Finance) 5:03 PM
uhhh... guys? we have something of a situation
Name wants us to shut down AP
[3 🗨️]

wombo combo (VP Public Relations) 5:05 PM
bruh
like 🗨️ percent entirely completely shut down??

Josephine (VP Finance) 5:05 PM
yup

she sent us an email with a bunch of grievances about it and then ganked me in the office to rant about it in person

lightSoul (President) 5:06 PM
haha Name Person in person 🗨️
[2 🗨️]

Josephine (VP Finance) 5:06 PM
she'll probably bring it to mathsoc council
I looked through the mathsoc policies and like there's nothing in there that she can actually use against us to shut it down??
Name pointed to the manacorp funding not being registered with mathsoc but i'll get that fixed up by monday

wombo combo (VP Public Relations) 5:07 PM
@Arthur (VP Gaming) you're on council right what do you think name's gonna do

Arthur (VP Gaming) 5:07 PM
Name has a ton of influence on Council. If we don't comply and shut down AP immediately, I suspect she'll bring it up at the next council meeting and try to get a special motion passed to force us to shut it down. If she's feeling particularly punitive, she could even try to place Gaming Club on probation...

wombo combo (VP Public Relations) 5:07 PM
why she gotta do us dirty like this brooo
[2 🗨️]

Josephine (VP Finance) 5:08 PM
idk about you all but i've put in too much work to just shut down awesome points

wombo combo (VP Public Relations) 5:09 PM
preach it sister

Arthur (VP Gaming) 5:09 PM
No way we go down without a fight!

lightSoul (President) 5:09 PM
🗨️
[3 🗨️]

Josephine (VP Finance) 5:11 PM
you're all awesome, you know?

i'm gonna get back in touch with manacorp and get our funding in line as well as bring those bylaws to my friend maria to see if mathsoc can really nail us on anything

arthur i want you to monitor mathsoc council channels and let us know as soon as name sends anything out as well as getting some idea of sentiment on council re: AP

wombo we're stepping up the current AP campaign double time

can you also draft up a “save AP” marketing campaign or something like that? i have a feeling we'll need it soon

lightSoul... remember that operation jupiter idea we once talked about? i think it might come in handy very very soon...
[2 👍] [1 🌀] [2 👁]

okay let's get this bread
[3 🍞]



AP LAUNCH — T + 8 DAYS

“What's uppppp, everybody!!!! Welcome back to your favourite gaming streamer, HiddenBread! I've got a special video for you brought to you by the good old University of Waterloo Gaming Club—for those of you who don't know, I graduated from that very university a few years ago and Gaming Club was definitely one of my faves there. Those guys do awesome stuff, just like these Awesome Points they've asked me to show off today!”

Sarah had dragged Wordpress over to her desk for some reason just to watch this video. In the video, HiddenBread walked through the Awesome Points program's basics: a point-based reward system for chatting and interacting with Gaming Club's online chat.

“Gaming Club didn't tell me to say this, but there's some sweet stuff some people have been doing with it too, like speedrunning to get a certain amount of points as quick as possible. At the top of the leaderboards for both 500 and 1000 point % are held by streamer ‘ya girl sarah’, at sweet times of 12:38 and 18:01 respectively.”

Sarah whooped, drawing a weary glance from Wordpress.

“And at very last, I have a few upcoming feature announcements to make on behalf of Gaming Club—Awesome Points is going public! Anyone who's not a University of Waterloo student are now eligible to join Gaming Club chat and earn Awesome Points for a small monthly subscription. New exclusive merch, rewards, and giveaways including an exclusive *Carnage of Glory* Wrath Skin and GamerPro XX7 Headphones are getting added to the Awesome Points shop. Make sure to use my exclusive affiliate link for a bonus five hundred Awesome Points when signing up!”

“Na way I missed tha part!” Sarah yelled. “*Carna' jo Glory* Wrath skin?! I gotta get more points!” She closed the browser tab and launched Gaming Club's online chat again.

Wordress sighed and shook her head. What was Gaming Club doing?

SHAMELESSLY STEALING GAMECHANGER IDEAS BUT THIS TIME IT'S MATH: LIKE MY COFFEE

I'm an avid GameChanger viewer, and while I'm sure you're reading this over a nice coffee and donut from C&D (fingers crossed it's open! [*Editor's Note: still closed :(*]), sometimes we need to, in corporate, “engage and connect with each other in these trying and difficult times.” So here's a bunch of ways for you to “complete the innuendos” with your friends, along with some of my own answers, but feel free to make your own!

1. I like my lovers how I like my threads...
2. I like my lovers how I like my matrices...
3. I like my lovers how I like my algebraic objects...
4. I like my lovers how I like my graphs...
5. I like my lovers how I like my compact spaces...
6. Sex with me is like a diophantine equation...
7. Sex with me is like a deterministic finite automata (DFA)...
8. Sex with me is like an integral...
9. Sex with me is like a binary search tree (BST)...
10. Sex with me is like a skip list...
11. Are you a bash script? Because...
12. Are you an epsilon delta proof? Because...
13. Are you a Taylor series? Because...
14. Are you in the class of Recursively Enumerable languages (RE)? Because...
15. Are you a **mathNEWS** writer? Because...

(Answers: 1. Concurrently; 2. Invertible; 3. With a ring on 'em; 4. With a connection; 5. Completing me; 6. Easy when it's linear; 7. Regular; 8. Hard at first but faster with tools; 9. Traversable with some effort; 10. No one ever uses me; 11. I want to sha-bang you; 12. I like feeling smaller than you; 13. We should sin together forever; 14. Saying yes to you is easy, but saying no to you is hard; 15. I want to meet up with you once every two weeks and have pizza;)

Xx_420SonicFan69_xX

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A mathNEWS EDITOR WHO'S ALREADY DESPERATE TO RETIRE

INT[5]: AN ACCESSIBLE LESSON IN LANGUAGE DESIGN

INCLUDES A FREE LESSON ON ALL THE BASICS!

Hello. It's me. I want to introduce you to a funny quirk in C++. I want this to be accessible for a change, so I'll first re-introduce all the relevant things from C, and build up to the problem in C++.

POINTERS AND ARRAYS

Oh boy, this is the good stuff. The funny stuff. The piss in everyone's Corn Flakes. You might've done CS 246 and still not really fully know what a pointer is; that's fine. It's okay. In short, a pointer is just an address. Variables in your program implicitly have associated memory addresses, at which the actual data lies. For example, let's say I declare and define a variable, `int x = 3`. I can then retrieve the address of `x` by writing `&x`. That is, `&x` is a pointer, to an `int`, so it has type `int*` (i.e. we could define `int* p = &x`).

This is the way pointers are introduced in CS 136. It's kind of stupid and useless and doesn't motivate them properly. The real reason we usually use pointers, in practice, is for *heap memory*. More on this soon.

You should also recall the easier part from CS 136, and that's *arrays*. We can declare an array, say of 5 ints, by doing something like `int arr[5]`. In general, if we wanted an array of type `T` of length `N`, we would write `T arr[N]`, where `arr` is just the variable name I picked. A very important part is also that these arrays have **fixed size**. That is, their size has to be known at compile time, so `N` has to be some constant expression that the compiler can evaluate. This means no size changes at runtime. To disambiguate later, we'll call these *fixed-size arrays*. Something to note is that, when syntactically discussing the *type* of something like `arr`, we say that it has type `T[N]`. Given this, you would expect that we would've declared it like `T[N] arr`. Nope. Not how it works. Oh well.

HEAP MEMORY

In a C program, your program's memory usage is split into four main parts: the code, static, stack, and heap memory. When you declare any sort of variable, say `int x = 3`, that variable lives on *the stack*, so called because the variables exist in a contiguous, fixed space of memory dedicated to their scope, and they are pushed/popped off like with a stack when they are declared/fall out of scope respectively. This is nice and easy, but it has a few drawbacks, the first being that a stack variable's lifetime is bound to its containing scope. So, as soon as the scope in which a variable was declared ends (e.g. the function ends or we finish a for-loop the variable is declared inside), the variable and its data cease to exist.

We get some similar roadblocks, too, when working with fixed-size arrays. In particular, these arrays fully live on the stack. The stack is fixed-size, which is what necessitates the arrays also having fixed size. This kind of sucks, right? It very common to want a container to hold your stuff, but you don't

know how much stuff you'll actually need to eventually hold at runtime.

Well, then, it's a good thing that we have *the heap*. The heap is much less tidy and safe than the stack. A lawless land, but without laws, we can have more fun. In summary, heap is a big chunk of memory that we can request pieces of from the operating system at any point at runtime. The interface we use to do this is a function called `malloc`. I'm sure that name just woke some of you up like sleeper agents, but calm down. We request a certain amount of memory on the heap by passing to `malloc` how much we want, and `malloc` returns a pointer (read: an address) which we now own, and at which our data can be stored. How much do we want? Exactly the amount, in bytes. Let's say we want a `float` on the heap. We would do something like this:

```
float* q = malloc(sizeof(float));
```

In this case, `malloc` allocates space for a `float` on the heap, and returns to us an address to that space it allocated. While `q` itself, the pointer, is a stack variable and bound to the lifetime of its containing scope, the actual content *to which `q` points*, i.e. `*q`, exists on the heap, and will live forever until explicitly killed with `free(q)` later on in the code. What if I want more than one? Then just ask for it:

```
int* p = malloc(5 * sizeof(int));
```

For the sake of demonstration, let's say in this case that `malloc` returns the address `0x400`. Here, we will now own five contiguous addresses at which we can store ints: we own `0x400`, `0x404`, `0x408`, `0x40c`, and `0x410`. We also own the addresses in between, but ints take up 4 bytes, so it only makes sense to talk about the first byte of each. In a sense, this allocates a contiguous "array" on the heap! And what's more is that the argument to `malloc` doesn't have to be a constant expression. What you might gather at this point is that this gives us a mechanism to do dynamic-length arrays, whose lengths may be determined at runtime rather than compile time.

Something I will stress at this point is that **arrays and pointers are not the same**. While I am using the "fixed-size" term to disambiguate, according to the standard, only things of type `T[N]` can actually be called arrays! These dynamic heap arrays, type-wise, are still just counted as pointers. They just might have space for more than one object.

So, here's a cute question: what if I want to allocate a fixed-size array of `T` of length `N`, on the heap (call it `y`)? Well, okay, since `malloc` returns a pointer, we're going to want to declare `y` as a pointer to a `T[N]` (if you want to compile this, replace `T` with `int` and `N` with some number like 5). More concretely, we declare it as follows:

```
T (*y)[N];
```

This is nonsense, it doesn't even look like a variable declaration. As a wise man once said, the C stands for Cute. But anyway, it reads like this because the `[N]` bit takes priority, so if we wrote `T* y[N]`, we'd actually be saying "let `y` be an array of `T*` of length `N`". Not quite what we want, so we use the parentheses to be explicit. To actually allocate it, we'd do it like you might expect:

```
y = malloc(sizeof(T[N]));
```

And that works! It actually gives us what we want. The way we access array elements is a little funky though: we need to dereference, *then* do our array access. That is, to access the `i`'th element, we'd write `(*y)[i]`. This is sort of funny and, as you can imagine, it's something a lot of programmers would probably screw up with and ruin their code. It's probably fine, though—not many programmers are out there allocating fixed arrays on the heap. Okay, so what gives? I don't see any problem here. I don't see what—

C++

Right. Naturally. Okay. Here's the thing: in C++, they don't want you to use `malloc`. That's low-level and ugly. Instead, they prefer that you use the **new** keyword for memory allocation. How's it work? Well, here's the rule: if we want to allocate a `T` on the heap, then we would write

```
T* p = new T;
```

and that'll do it, with `new` acting much like `malloc` in giving us a pointer to the memory allocated. So, here's the problem: I want to do the same thing in C++. A fixed array on the heap. Let's try:

```
T (*p)[N] = new T[N];
```

Now, it won't compile. What? Is GCC OK? Yes. GCC is always OK. The thing is, this piece of code doesn't actually allocate a stack array on the heap. Instead, `new T[N]` will allocate a dynamic array of `N` `T`'s on the heap, and give us a pointer to the first element. So this is functionally equivalent to `malloc(N*sizeof(T))`. So then the compiler complains because, hey, this thing on the right-hand-side is a `T*`, not a `T(*)[N]`! You traitor!

It's not all GCC's fault; I wasn't being completely honest with the rules earlier. There's a wrinkle I didn't mention. Here are the revised rules:

1. If `T=U[N]` is an array type, then **new** `T` allocates a dynamic array of `U` of length `N`, i.e. on the heap, and hence returns a `U*`.
2. Otherwise, **new** `T` allocates a `T` on the heap, and hence returns a `T*`.

Alright, now this is interesting. This suggests that it's actually not possible to just allocate a single `T[N]` on the heap. The best approximation we could do is with something like `new T[1][N]`, which would allocate a dynamic array of `T[N]` of length 1.

That feels like cheating, though, so I don't count it. So, unless you cheat and write some slightly dishonest code, you can't really do this with the standard `new` syntax. What gives? Why do array types have this special syntax expression? Why is C++ such a syntactically inconsistent language? Why is Bjarne Stroustrup such a god damned psycho?

ANALYSIS

So, this isn't just some weird corner case that the C++ people forgot about. No, this is very deliberate; it's by design. There is a reason for this, and it's a pretty simple one: it's because programmers are going to be stupid. If you make it easy for programmers to make a stupid foreign object like this with `new T[N]`, you're very soon going to find a lot of uninformed programmers on StackOverflow having accidentally created a `T(*)[N]`, a funky type of which they don't know you're supposed to access elements in a funky way. You're going to make it a lot harder for people to know what they're doing in the most common cases. Moreover, if this exception didn't exist, then there wouldn't really be a way of allocating true dynamic arrays on the heap with the syntax as-is. Sure, we could try adding some extra syntax, so maybe you'd do `new [N] T` if you really wanted a dynamic array of `T` of length `N`. But that's even more confusing, unintuitive syntax for programmer brains to figure out. Honestly, even though it's technically inconsistent, there's something attractive about `new T[N]`. It's very nice and intuitive; it gives you a dynamic array of `T` of length `N`. Most programmers don't even bother with fixed arrays these days; it just makes more sense to give them easier syntax to do the things you expect them to want to do the most. And with C having existed for many years at the time of C++'s birth, I suspect Bjarne and co. had a pretty good idea of how people were using that language. I can't say I blame them for optimizing it this way; they were crafting a better user experience.

jeff

Here at mathNEWS, we are not afraid to seek the answers to your toughest questions.

Of course, that doesn't stop us from posing your idiotic ones too.

THE mathASKS AMBASSADOR

S (S (S (S 0)))

There's an idea in storytelling, called reverse chronology, wherein we begin a narrative with its ending.

Admission 4.1. I am unable to determine whether or not Coq is a legitimate programming language.

It may seem counterintuitive in that it seemingly neuters the dénouement's suspense, yet the backwardness can add an intrigue that would not have been had otherwise. For indeed, how did we end up here?



Flashback: remember our finite state machines? The finite directed graphs that terminated successfully on some input strings and threw errors on others? Suppose we were to collect some set of strings from a given alphabet. We would call this a language. Suppose then that, given an FTM, we took the subset of our language that our machine successfully computed. We would call this a regular language.

Last week, then, the subset of binary strings with an even number of zeroes was a regular language, as verified by the machine there depicted. The set of all finite strings of parentheses that are properly balanced, on the other hand, was not. Fairly limiting, as far as languages go.

Recall now that we were able to think of FTMs as Turing machines of finite memory tape. This is a powerful limitation—with an infinite memory tape, we get all of computation. Suppose we were to make ourselves a machine with its capabilities somewhere in the middle: infinite memory, but restricted to the form of a stack. Without getting bogged down in the details, we would in fact end up with a device more powerful than FTMs, but not equivalent to full Turing machines. We'll call these pushdown automata.

Among other things, observe that the stack allows for successful computation of languages with arbitrary numbers of matching parentheses. As such, we have access to a family of languages a little stronger than regular. We'll call these context-free languages.

Context-free languages are formalized through context-free grammars, which the reader can read more about should they be interested. For our purposes, however, an intuitive notion will suffice. In essence, context-free languages are those defined by a collection of base cases, as well as a collection of inductive rules. For example, with a context-free language of just balanced parentheses, we would say that the string $()$ is in the language, that if strings v, w are in the language then vw is too, and that if string v is in the language then so is string (v) . Note that the rules consist both of variables representing strings in the language, as well as literals for symbols in the language's alphabet. The reader can imagine certain restrictions that would be in place on the inductive steps to ensure well-foundedness or finite termination, had the definition been fully stated. We'll take those for granted. (Sidenote:

while the rules of a context-free language can be stated such that every string in the language is only reachable through a unique sequence of rules, as with our parentheses above, this is strictly unnecessary.)

Hopefully I'm not alone in seeing how Coq-able context-free languages are. It turns out to be fairly straightforward—for our parentheses language, we might state it as follows:

```
Inductive parens : Set :=
| pair : parens
| wrap : parens → parens
| cons : parens → parens → parens.
```

The bit that seems a bit unwieldy is the concatenation operation, but it gets the trick done. Having a proof of concept, we can turn our attention to our best friend. Ah, but you already know, don't you? Flashforward: we failed.



Before we proceed, notation: $(*)$ means "I have no clue". Now, the actual definition isn't that hard:

```
Inductive bf : Set :=
| add : bf
| sub : bf
| mvl : bf
| mvr : bf
| inp : bf
| out : bf
| loo : bf → bf
| con : bf → bf → bf.
```

The first six should be familiar, the seventh is like our `wrap` above for the `[...]` syntax, and finally the `con` again for concatenation. The issue then lies with everything else. We'll need to somehow define a function that takes in a `bf` and "evaluates" it. Defining functions on Inductive definitions can be done through the `Fixpoint` keyword. We'll get back to that. First, though, we need an array of memory cells, an input, and an output. How? For this, we turn to user `reynir` on GitHub for inspiration.

In their implementation, the memory array is implemented as a natural number along with two natural number streams: a left and a right. Incrementing and decrementing are operations on the number, while shifting left means appending the number to the start of the right stream, then taking the first element of the left stream as the current number, and vice-versa. In this manner, we get an "infinite" tape. Input and output are a stream and a list respectively. We can get all of this data into a single structure with something along the lines of:

```
Inductive BF : Set :=
| bind : nat → Stream nat → Stream nat → Stream nat →
list nat → BF.
```

Now here's where things get interesting: Inductive structures are necessarily finite on their constructors. Yet this `Stream` structure we're using is infinite in nature. In `Coq.Lists.Streams`, they are defined as:

```
CoInductive Stream (A : Type) := Cons : A → Stream A →
  Stream A.
```

The `CoInductive` definition has non-terminating induction. Because of `(*)`, we actually say `Inductive` and `CoInductive` are dual to one another. A function on `CoInductive` is then defined not through `Fixpoint`, but `CoFixpoint`. For example, we will want a `CoFixpoint zeroes : Stream nat := Cons 0 zeroes.`, to represent the initial state of our memory and input (this should look familiar to you CS145 takers).

Now, employing `Coq`'s powerful pattern matching, we should be able to define a `Fixpoint` that takes in a single string of the `bf` language, a single data structure of the `BF` variety, and operate on that data to return some final `BF`. Right?

```
Fixpoint step (i : bf) (s : BF) : BF :=
  match i, s with
  | add, bind 255 bfl bfr bfi bfo ⇒ bind 0 bfl bfr bfi bfo
  | add, bind bfc bfl bfr bfi bfo ⇒ bind (S bfc) bfl bfr bfi
    bfo
  | sub, bind 0 bfl bfr bfi bfo ⇒ bind 255 bfl bfr bfi bfo
  | sub, bind (S bfc) bfl bfr bfi bfo ⇒ bind bfc bfl bfr bfi
    bfo
  | mvl, bind bfc (Cons l bfl) bfr bfi bfo ⇒ bind l bfl
    (Cons bfc bfr) bfi bfo
  | mvr, bind bfc bfl (Cons r bfr) bfi bfo ⇒ bind r (Cons
    bfc bfl) bfr bfi bfo
  | inp, bind bfc bfl bfr (Cons i bfi) bfo ⇒ bind i bfl bfr
    bfi bfo
  | out, bind bfc bfl bfr bfi bfo ⇒ bind bfc bfl bfr bfi
    (bfc :: bfo)
  | loo ins, bind 0 bfl bfr bfi bfo ⇒ bind 0 bfl bfr bfi bfo
  | loo ins, bind bfc bfl bfr bfi bfo ⇒ step (con ins (loo
    ins)) (bind bfc bfl bfr bfi bfo)
  | con ina inb, bind bfc bfl bfr bfi bfo ⇒ step inb (step
    ina (bind bfc bfl bfr bfi bfo))
  end.
```

Alright, alright. Let's walk through it slowly. On the leftmost hand, we're branching through every single possibility for something defined by `Inductive bf`. Right beside it we're breaking down the objects that were `bind`d together by the `Inductive BF`. Then, we operate on it by returning whatever is to the right of the `⇒` in that particular case. In the first line, for example, if the symbol was the `add` one and the current cell was at 255, we'd return to 0. Otherwise, as the second line says, we'd take the natural successor. `mvl` and `mvr` operate as implemented by `reynir`. But this doesn't compile. Of course it doesn't.

We get an interesting error: "Cannot guess decreasing argument of `fix`." See, due to, like, logic `(*)` and stuff `(*)`, `Coq` requires that recursive functions terminate. In other words, the structure we're recursing on must be getting smaller.

Were we operating on the naturals, we'd expect a `Fixpoint` to have a base case 0, and operate `S n` in terms of `n` (as opposed to `S (S n)`). We have two structures here, the `bf` and the `BF`. `Coq` doesn't know which is getting smaller. No matter, we can explicitly tell it with `Fixpoint step (i : bf) (s : BF) {struct i} : BF := ...`.

New error: "Recursive definition of `step` is ill-formed." Take a look at the second `loo ins` line. In this case, we have matched a `bf` string within a loop, with the order to execute it once, as the current memory cell is nonzero. To do so, we call our `step` function again with the `bf` string `cons ins (loo ins)`: concatenate one execution with the remainder of the loop. But that's not a decreasing argument: in fact, our structure is growing in complexity. `Coq` doesn't have any guarantee that our definition will terminate, and neither do we by Turing's halting problem.

Okay, fine. Huh. But `CoInductive`. That doesn't necessarily terminate, does it? What's going on? `(*)`. `(*)`. `(*)`.

But hold on: Adam Chlipala in his `Coq` textbook does something interesting. He encodes the notion of a "computation" as a `CoInductive`. If we were to un-polymorph the definition and apply it to our `BF`, we get:

```
CoInductive comp : Set :=
  | ans : BF → comp
  | thk : comp → comp.
```

Briefly (though again, `(*)`), if we have an answer we can return it was a computation. Else, we have further work to do, and we encode that as what we call a `thunk`, which we then pass again into the `CoFixpoint` we're cooking up. Somehow once if all works `(*)` we'll probably have to `(*)` extract the result from the `thunks` `(*)`. That's a problem for later `(*)`. While a `Fixpoint` has strong restrictions on its inductive step, a `CoFixpoint` only requires that the recursive call be "guarded" by a `CoInductive` constructor: here, those would be `ans` and `thk`. This is due to reasons `(*)`.

Altogether, then:

```
CoFixpoint step (i : bf) (s : comp) : comp :=
  match i, s with
  | add, ans (bind 255 bfl bfr bfi bfo) ⇒ ans (bind 0 bfl
    bfr bfi bfo)
  | add, ans (bind bfc bfl bfr bfi bfo) ⇒ ans (bind (S bfc)
    bfl bfr bfi bfo)
  | sub, ans (bind 0 bfl bfr bfi bfo) ⇒ ans (bind 255 bfl
    bfr bfi bfo)
  | sub, ans (bind (S bfc) bfl bfr bfi bfo) ⇒ ans (bind bfc
    bfl bfr bfi bfo)
  | mvl, ans (bind bfc (Cons l bfl) bfr bfi bfo) ⇒ ans (bind
    l bfl (Cons bfc bfr) bfi bfo)
  | mvr, ans (bind bfc bfl (Cons r bfr) bfi bfo) ⇒ ans (bind
    r (Cons bfc bfl) bfr bfi bfo)
  | inp, ans (bind bfc bfl bfr (Cons i bfi) bfo) ⇒ ans (bind
    i bfl bfr bfi bfo)
  | out, ans (bind bfc bfl bfr bfi bfo) ⇒ ans (bind bfc bfl
```

```

bfr bfi (bfc :: bfo))
| (loo ins), ans (bind 0 bfl bfr bfi bfo) => ans (bind 0
bfl bfr bfi bfo)
| (loo ins), ans (bind bfc bfl bfr bfi bfo) => thk (step
(con ins (loo ins)) (ans (bind bfc bfl bfr bfi bfo)))
| (con ina inb), ans (bind bfc bfl bfr bfi bfo) => thk
(step inb (step ina (ans (bind bfc bfl bfr bfi bfo))))
| i, thk s' => thk (step i s')
end.

```

Note how the final match is a sort of catch-all for thunk-wrapped computations, unwrapping them as we go along. Does it accomplish what it is meant to accomplish? Nnn-yes (*).

☞

In any case, dear reader, this story only has one ending. “Recursive definition of step is ill-formed.” Why? In the second last match, where we decomposed the concatenation of `ina` and `inb`, we called `step` twice. But as (*) would dictate, recursive occurrences cannot be nested.

This is not to say `Coq` is not legitimate, as demonstrated by the individual referenced above (see <https://github.com/reynir/Brainfuck>). But us? We're a little off. Or maybe a lot off. (*).

☞

Amendment 4.1.1. Yet.

hu

GCWM ENDS PANDEMIC BY REDEFINING THE METRE

PARIS—In a shocking upheaval of their 2018 resolutions, the General Conference on Weights and Measures (GCWM) has announced that they would once again be changing one of the fundamental SI units.

“Over the past two years the metre has been steadily getting shorter. We can no longer pretend that it is the distance travelled by light in 3.3 nanoseconds.” director Ellen Si said at a press conference yesterday. “To reconcile science with public opinion, the metre will be redefined to one half of the radius of your personal space.”

People around the world rejoiced at the news, packing into house parties and bumping elbows when walking down hallways, just like they have done for the last year. Regional governments breathed a collective sigh of relief that two-metre distancing would finally be enforceable. Ruler manufacturers hit record highs on the stock market.

Not everybody is happy, though. Doctors and public health officials took to Twitter last night to criticise the changes. “You

can't just end the pandemic by scaling down some units!” one doctor wrote. The official GCWM account simply responded “We did our own research.” Time will tell if this new definition is truly for the better.

water

TOUCH STARVATION

After the article [I Don't Live Here Anymore](#), I was expecting that for the remainder of Fall and Winter 2021, I would be remaining in Waterloo with a brief trip back home for about two weeks, with the expectation that I would be back in January to work on my job applications and such. Unfortunately due to the Omicron outbreak, I was forced to remain in Markham while \$625 was withdrawn from my bank account for a room unoccupied. When I left, I had also left my DJUNGELSKOG sat on my swivel chair outside of my room, a surprise for my housemate when he came back. That DJUNGELSKOG and chair were left outside for two weeks before I came back to check that nothing had gone wrong.

I wonder about that DJUNGELSKOG. He's been left in an empty apartment, sat on a chair, for days on end. No longer can he bear witness to me and my three housemates as we go about our lives, our triumphs and struggles. No longer will he feel my embrace.

Alone.

It's cold. You want to feel the tender embrace of something, someone who acknowledges you, knows you to be enough for them. You want to feel secure and safe, and yet you're alone in bed. Blankets can only warm you physically, but the emotional warmth has to come from connection. It gets to a point where even the slightest touch feels intimate, even though it may be a tap on the shoulder or someone grabbing you and shaking you back and forth out of crazed mania. You spend your days listening to bedroom pop and 80s hits from a different time, scroll through social media past the doom mongering and bad takes to see people with each other. Held back by the social boundaries society has set. Are people who touch each other comfortably friends, or something more? You toss and turn in your sheets and drift off to sleep, alone.

You'd kill for a hug.

Skit

A feature is just a documented glitch.

PROF. IAN MUNRO

OPINION: THE FED BUS NEEDS TO GO

The Fed Bus: the second most comfortable and economical way of getting to Toronto ending with “Bus.” Of course, the most comfortable and economical way of getting to Toronto ending in “Bus” is the GO bus, which anyone taking the Fed Bus should be seriously considering as an alternative (arguably, it is also the second most comfortable and economical way of getting to Toronto starting with “Fed,” but that is not the subject of this article).

For many people, the first consideration on an hours-long bus ride would be comfort, which is an area that GO Transit excels in, hands down. While the Fed Bus makes use of school buses, GO Transit makes use of MCI D4500CT and ADL Enviro500 motorcoaches (mostly the latter on UW routes). As anyone who has been on both a school bus and a motor coach will tell you, a motor coach is a much more comfortable ride. Whereas a school bus has an interior of sheet metal, with flat, unsupported and non-adjustable benches reminiscent of the rear seating on the Mitsubishi Mirage (see the Doug Demuro review for context), a Go Transit coach is a beautifully furnished coach with carpeted walls and a carpeted roof, separate luggage compartments (Fed Bus has no luggage space at all, with luggage limited to lap bags), and amenities such as LCD screens, 120V AC/USB outlets, and WiFi so that you can be productive during the ride! However most importantly, it has comfortable, contoured, and reclining seats for a much more comfortable long-haul experience. Fundamentally, school buses are a truck chassis designed to satisfy the bare minimum for children who have no other options of transport, whereas GO Transit is a service primarily geared towards middle-income commuters who have the choice of driving a car to work, and the difference really shows in terms of passenger comfort.

However, it is undeniable that tuition and other expenses can quickly add up, leaving little remaining in the budget for travel. For this, you may also be pleased to hear that GO Transit is also the more economical option of traveling home for most students. While most Fed Bus fares are in the \$18–20 range, a weekend (or holiday) day pass on the GO costs only \$10, with all-weekend passes (also including any adjacent holiday) costing the low price of \$15. Even without this promotion, however, GO Transit still comes out cheaper than the Fed Bus for many routes (see chart). *[Editor's Note: New GO fare discounts for post-secondary students were announced after time of writing, on March 1st: <https://www.gotransit.com/en/blog/save-with-new-fare-discounts>.]*

FED BUS DESTINATIONS AND ALTERNATIVE GO TRANSIT OPTIONS

DESTINATION (FED BUS)	DESTINATION (GO TRANSIT)	FED BUS FARE	GO TRANSIT FARE (STUDENT, W/PRESTO)
York Mills Station	York Mills Station	\$18	\$15.04 (transfer at Bramalea GO)
McCowan Station	Scarborough Centre	\$18	\$16.66 (transfer at Bramalea GO)
Richmond Hill Highway 407 Express	Richmond Hill GO	\$20	\$17.59 (transfer at Bramalea GO)
CF Markville	Centennial GO	\$20	\$14.46 (transfer at Bramalea GO, Yonge @ Hwy 407)
CF Masonville	London VIA Station	\$15	\$17.50 (Presto not avail, Adult ticket, transfer @ Kitchener GO)
Aldershot GO	Aldershot GO	\$13	\$15.92 (Transfer at Erin Mills Transitway, Hamilton GO)
Jackson Square	Hamilton City Hall	\$13	\$15.92 (Transfer at Erin Mills Transitway)

Thus, it is clear that for Fed Bus destinations in the GTA, GO Transit is more economical than the Fed Bus.

While GO Transit does require transfers for most destinations in the GTA, it should be noted that these are only the GO Transit stops closest to approximate Fed Bus destinations. The GO bus serves many more stops than the Fed Bus does not (including Pearson Airport, an important destination for international students and those departing for Cali), and

**Advanced math is easy.
Simple math is tough.**

PROF. JONATHAN BUSS

there will likely be a stop closer to where you live that would greatly offset the extra transfer that would be needed with GO. Furthermore, most GO Transit stations have plenty of connections with local transit, dedicated bus shelters, and lots of parking, whereas it is unlikely that the Fed Bus has access to similar amenities. Thus, whether you are connecting with the local transit (MiWay and YRT both have GO Transit co-fares, meaning that you pay less when transferring from GO), or getting picked up from the GO station, the GO bus provides an all around better experience.

Moreover, the GO bus currently runs once an hour, with more (sometimes express) buses added during times of high demand, such as reading week.

Overall, the greater comfort, dedicated luggage space, better fares, more destinations, much better frequency, and better local transit connections makes GO Transit a hands down winner for any destination in the GTA, and makes for a better travel experience even for destinations outside of the Greater Toronto Area.

tokyocatboy's travel notes:

- The older GO coaches (2420–2482) have the softest seats (American Seating 2095 Recliner)
- The newest GO double-deckers (8522–8567) have USB outlets on the back seats for charging
- Most other coaches have 120V AC outlets at some seats
- The older GO double-deckers (8101–8205) do not have dedicated luggage space; however there is still plenty of interior space on the first floor for luggage. These are currently all parked due to COVID-19
- 4000 and 4001 are battery electric double-deckers!

Happy travels! Nya!

tokyocatboy

FIVE-SEVEN-FIVE KERNEL DUMP

Snow freezes and melts
Sidewalks are covered in ice
Unplanned Tokyo Drift

~

Lectures in MC
Rush to make it there on time
Good seats for Zoom class

~

Morning, bus driver
Why the sudden weird look?
Fuck—forgot my mask

~

Wait outside in cold
Isolated by music
“Just a Coke, please—thanks”

~

Bus, bus, train, bus, train
Look around for a chip, find
Memories instead

~

People confuse me
Do I want to be like them?
Do I just want them?

I know who I am
And who I could never be
They are the same thing

~

Am I a leader?
I barely know where to go
Good luck to you all

~

Excitement winds down
As hours and minutes tick by
Silence still greets me

~

Mind needs to compute
Doing things keeps me happy
Spinlocks grind my gears

~

Need something to eat?
This short rhyme is sponsored by
iNews SLC

tendstofortytwo

iNews didn't actually sponsor this but I'll happily shill them anyway.

spaceNEWS II: WEBB LAUNCH SUCCESSFUL, POLARIS MISSIONS, AND RUSSIAN SANCTIONS

It has been a few months since the previous issue of **spaceNEWS**, during which the long-awaited James Webb Space Telescope has successfully launched and deployed its large 18-segment mirror. However, it will still be many months before the JWST becomes operational as it further calibrates itself and chills its sensors to cryogenic temperatures. This step is critical as the JWST is an infrared telescope, to prevent the infrared glow from the telescope itself from overpowering the sensors.

In other news, what was thought to be the upper stage of a Falcon 9 that was poised to collide into the moon has been revealed to be the upper stage of a Chinese rocket. The NOAA's DSCOVR weather satellite, launched by SpaceX in 2015 was thought to be the original source of the object. It was later confirmed to be from a Chinese Long March 3C rocket that launched the Chang'e 5-T1, an uncrewed Chinese lunar mission.

Billionaire CEO Jared Isaacman has announced the Polaris Program consisting of a series of 3 crewed research flights. Previously, Isaacman has funded the Inspiration4 mission notable for being the first all-commercial space mission as well as a fundraiser for the St. Jude Children's Hospital. The first mission of 3, named "Polaris Dawn", aims to reach the highest earth orbit ever flown by humans in a SpaceX Crew Dragon capsule. It is also noted that a spacewalk is planned during this mission, a feature which the Crew Dragon capsule is not capable of. Currently, the 4-seater SpaceX capsule lacks an airlock, allowing for astronauts to exit the capsule into deep space (currently astronauts can only exit the capsule when it is docked to the ISS) as well as lacking a suitable EVA suit for it's occupants (an EVA suit is the type of spacesuit worn on a spacewalk, different from the one worn inside the vehicle). This will be a significant upgrade as it will allow for the use of Crew Dragon to perform maintenance on the Hubble Space Telescope, a capability that was lost in 2011 with the retirement of the Space Shuttle. Currently, not much is known about Polaris mission 2 other than that it will launch in another Crew Dragon. Polaris Mission 3 is expected to be the first flight of Starship with crew on board, marking a significant milestone for the next-generation SpaceX rocket designed to colonize Mars.

While **spaceNEWS** is not a political publication, it must be mentioned that the Russian invasion of Ukraine as well as the sanctions placed against Russia will have a significant effect on the American space industry. The Antares rocket built by Northrop Grumman along with the Cygnus spacecraft, along with the Cargo Dragon, are the only two American spacecraft capable of carrying cargo to the International Space Station. However, the Antares relies on a Ukrainian-built first stage with Russian engines, the factory for which has reportedly been destroyed by Russian fire. Currently, Northrop Grumman has two Antares first stages in storage, forcing Northrop Grumman must source an alternative rocket for the Cygnus

should it wish to remain operational. While the Cygnus has previously launched on the Atlas V (which also uses Russian engines), the rocket has been discontinued with all remaining launches already sold meaning that the Atlas V is no longer a viable option for Cygnus. This leaves the Falcon 9 as the only remaining American launch vehicle currently in service capable sending both crew and cargo to the ISS, meaning less redundancy for NASA (in case the Falcon 9 experiences a failure), a largely unavoidable outcome that they would predictably not be happy with.

With so much news and uncertainty in the industry, the next few months may prove to be even more interesting than the last few for those following or interested in spaceflight. Keep your eyes peeled!

tokyocatboy

NOTICE OF STRIKE

We the writers of **mathNEWS** henceforth declare that we will withhold contributions to this publication until we are appropriately compensated with the pizza promised to us by the editors in perpetuity.

1. Deriving for Dick
2. jeff
3. elaichi
4. methNEWS
5. hu
6. χ
7. osama
8. vincegh
9. aphf
10. haha, I'm not going on strike
11. ilia
12. A cool pen name
13. Whild
14. water
15. peacelovemath
16. PhilosophicalSoul
17. WM
18. Xx_420SonicFan69_xX
19. Skit
20. Not a N*rd
21. SecretSquirrel

Additionally, Golden strongly objects to the lack of pizza but felt like writing.

mathNEWS writers UNION

[Editor's Note: Don't mind me. Just taking notes...]

THE ENGLISH LANGUAGE NEEDS PARENTHESES (OR AN EQUIVALENT) FOR SPECIFYING SPECIFICITY

There, I said it.

There are too many problems with the English language to count, and in this article I will not attempt said counting—maybe consider talking to a nearby linguist and/or number theorist for that.

But what I will attempt to do is show to you, dear reader, that a large proportion of those problems—not the majority, by any means, but in my opinion too many to ignore—come from the fact that expressions in the language that cannot unambiguously resolve to a single meaning have no way of getting their meaning clarified by the original author.

Consider, for example, the following sentence:

The Member of Parliament sought advice for the fossil fuel bill from his wife, a sustainability advisor and an oil company executive.

Without parentheses, it is unclear whether the MP is engaging in due diligence or a massive conflict of interest. With parentheses, both of these meanings can become apparent:

The Member of Parliament sought advice for the fossil fuel bill from (his wife), (a sustainability advisor) and (an oil company executive).

Compare this to:

The Member of Parliament sought advice for the fossil fuel bill from (his wife, (a sustainability advisor and an oil company executive)).

It is clear in the first case that the wife, the sustainability advisor, and the oil company executive are different people, whereas in the second case, “sustainability advisor” and “oil company executive” are just descriptions of the wife. Figuring out which one constitutes a conflict of interest is left as an exercise to the reader.

I can already hear the skeptics starting to go on about how Oxford commas solve this—yes, they do, but can they represent this?

The Member of Parliament sought advice for the fossil fuel bill from (his wife, a sustainability advisor) and an oil company executive.

And that’s not even beginning to consider the cases where the Oxford comma does not apply. For example:

Can someone hand me a pencil? I need something to take notes and shit with.


Without external context, it is unclear whether this means:

Can someone hand me a pencil? I need something to take (notes and shit) with.

or:

Can someone hand me a pencil? I need something to (take notes) and (shit) with.

A variant of this example (with some details omitted for the purposes of confidentiality) actually happened to me. Go on, laugh. Laugh at the fact that somehow I’m supposed to be taking a shit with the help of a pencil. How? Don’t ask me, ask the person who just said this in the chat:

> and shit with


And the Oxford comma won’t save you here either—it’s simply not applicable here. The only solution I’m aware of is parentheses—and seeing how I just used parentheses to clarify the meaning of every single example so far and you just understood what that means without any difficulty indicates to me that it’s a good one.¹

There is, of course, an elephant in the room, one that I have not yet addressed so far because that’s what an elephant in the room means. The problem, you see, is that parentheses already mean something in the English language—they are containers for additional detail and context! I can show this by rewriting the third meaning of my first example in a more traditional way:

The Member of Parliament sought advice for the fossil fuel bill from his wife (a sustainability advisor and an oil company executive).

So in that case, what else can we use for parentheses? My first suggestion would have been [square brackets], but those often carry the same meaning as parentheses in this context. Instead, may I suggest curly braces:

Can someone hand me a pencil? I need something to take {notes and shit} with.

They don’t have that same overloaded meaning that parentheses and square brackets do, they already exist on existing keyboards, and they are already familiar to a subset of the human population (programmers) for the same purpose! Consider the following C++ code²:

```
if(condition)
    std::cout << "condition!" << std::endl;
std::cout << "always ..." << std::endl;
```

And with braces:

```
if(condition) {
    std::cout << "condition!" << std::endl;
    std::cout << "also condition!" << std::endl;
}
```

I rest my case.

tendstofortytwo

1. Here is what I would bring up something like a severability clause – even if you did not understand the examples without any difficulty, that should not deduct from the fact that the rest of my argument still applies.
2. Yes, I'm hopping onto the C++ article bandwagon. Sue me.

NOTWITHSTANDING

I am generally a pro human rights person. Not that that's something unique; if you ask pretty much anybody, they'll agree that human rights are important.

So why do we, here in Canada, have a device specifically designed to work against what we have agreed to be the most important rights of our people?

I am, of course, talking about the Notwithstanding Clause, a piece of Canadian politics that is baffling and terrible to me.

For those unfamiliar, Section 33 of the Canadian Charter of Rights and Freedoms, better known as the Notwithstanding Clause, can be used by any province or territory in Canada to override a few of the most important other sections of said charter as long as they have a majority vote.

I feel like this is a gross failure of our legal system and am shocked that it does not dominate election cycles. When any majority can overrule a minority and deny basic human rights to a group of people... it simply does not sit right with me.

The reason I'm writing this article now is due to the recent legislation in Texas discriminating against trans people. It's scary to think that hypothetically a province could use the Notwithstanding Clause to enact similar laws here.

I think that no matter where you stand on the political spectrum, this is a legal loophole that should be closed as soon as possible. Our rights and freedoms are our most important things as Canadian citizens, and while the abuses of this Clause have tended to be few in number, whenever it's evoked we're reminded of the potential harm that it could enact.

I hope by writing this article I can convince at least a few more people to care about this thing that only a few Canadians really put any thought into.

Predep

EPISODE 33: STATISTICAL DISTRIBUTIONS & EPISODE 34: MATRIX MULTIPLICATION

It's a double publication from MathSoc Cartoons! Enjoy Episode 33 and 34 of the MathSoc Cartoons series: *STAT 230* — *Statistical Distributions* and *MATH 136* — *Matrix Multiplication*!

Additionally: MathSoc Cartoons is hiring PAID comic writers and artists for Spring 2022! If you love explaining concepts, drawing comics, or telling bad math puns, hurry and apply by March 25 at <https://bit.ly/join-cartoons-team>! Please note that artists applying this term must submit an example of a cartoon/comic. If you don't have previous comic experience, @mathsoccartoons on Instagram has a sample script that you can draw up to submit!

MathSoc Cartoons

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"Matrix Multiplication" is © 2022 Clara Xi, all rights reserved. Published under licence by MathSoc. Do not reproduce.

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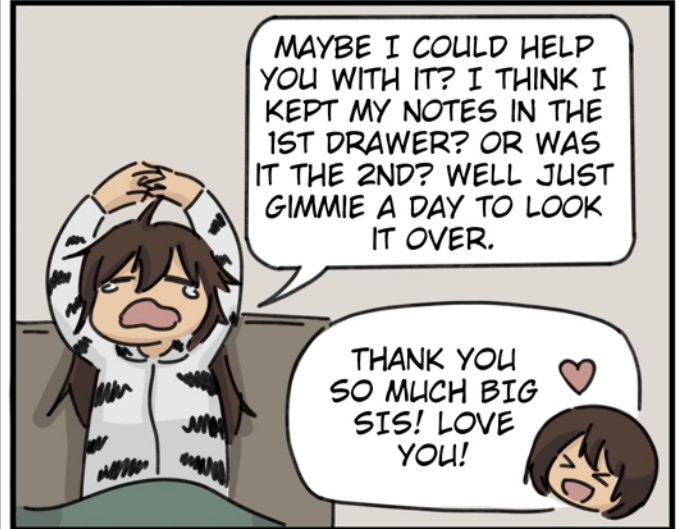
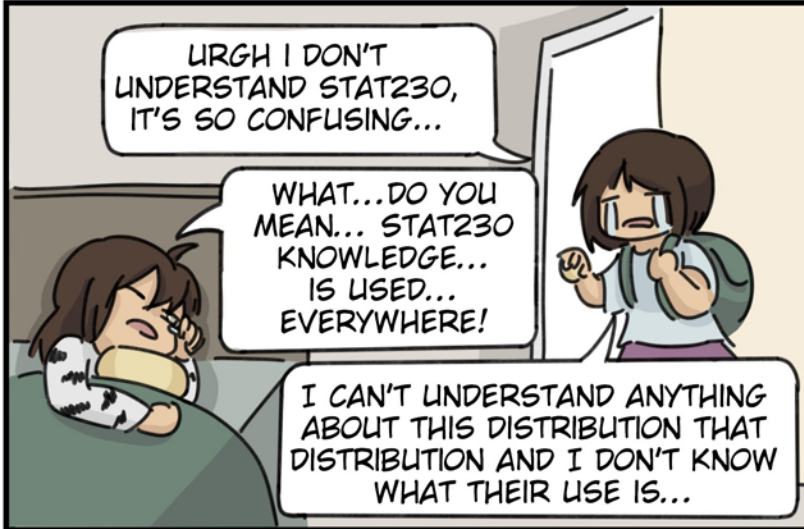


My brain, it's just... gone.

PROF. MARK GIESBRECHT

STAT 230: STATISTICAL DISTRIBUTIONS

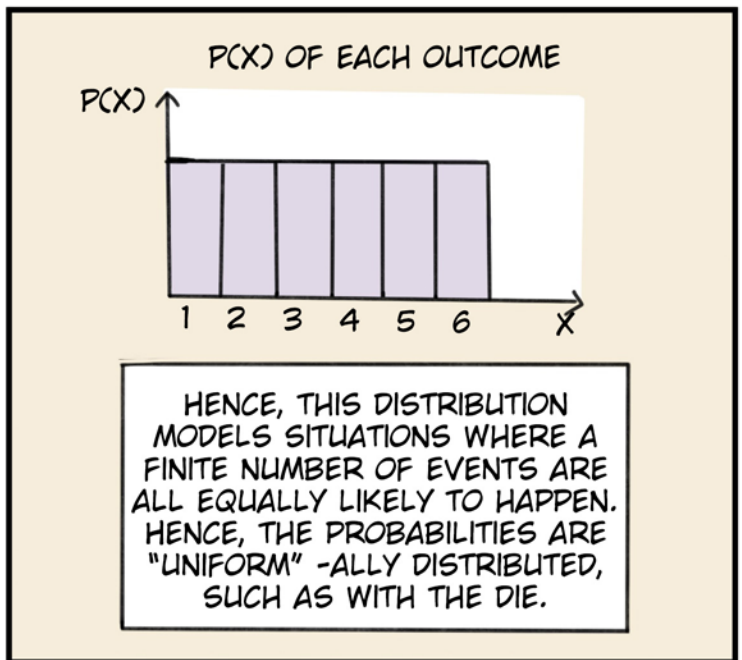
STORY BY JIA FENG YU, ART BY LISA WEI



THEA'S STAT230 TUTORIAL

DISCRETE UNIFORM

A GOOD EXAMPLE FOR THE DISCRETE UNIFORM DISTRIBUTION WOULD BE A FAIR, EMPHASIS ON FAIR, DIE, WHERE ALL SIX SIDES HAVE AN EQUAL CHANCE OF BEING ON TOP.



BINOMIAL DISTRIBUTION

NEXT, TO EXPLAIN THE BINOMIAL DISTRIBUTION, IMAGINE IF WE WERE DRAWING CARDS FROM A DECK, REPLACING THE CARDS BACK, AND COUNTING THE NUMBER OF BLACK CARDS DRAWN.

EACH DRAW IS INDEPENDENT FROM THE PREVIOUS, IMPLYING THE INDEPENDENCE OF EACH DRAW (EVENT). THIS TYPE OF SAMPLING IS SAMPLING WITH REPLACEMENT. THE BINOMIAL DISTRIBUTION MODELS SUCH SAMPLING. NOW, IF WE DECIDE TO SAMPLE WITHOUT REPLACEMENT, ...

STAT 230: STATISTICAL DISTRIBUTIONS

STORY BY JIA FENG YU, ART BY LISA WEI

HYPERGEOMETRIC DISTRIBUTION



WE WOULD BE USING THE HYPERGEOMETRIC MODEL! THE HYPERGEOMETRIC DISTRIBUTION IS ALMOST IDENTICAL TO THE BINOMIAL DISTRIBUTION EXCEPT THAT THE EVENTS ARE NO LONGER INDEPENDENT.

TAKING THE SAME EXAMPLE OF DRAWING CARDS, WE WOULD NOT PUT THE CARDS BACK AFTER EACH DRAW, MEANING THAT EACH DRAW AFFECTS THE FOLLOWING ONE. HENCE, EACH EVENT IS NO LONGER INDEPENDENT.

POISSON DISTRIBUTION

FINALLY, THE POISSON DISTRIBUTION, NAMED AFTER FAMOUS FRENCH MATHEMATICIAN SIMÉON DENIS POISSON, WHERE EVENTS HAPPEN INDEPENDENTLY, BUT AT A CONSTANT RATE OVER TIME.

POISSON

ISN'T THAT HER HALLOWEEN COSTUME FROM LAST YEAR?

CONSIDER MODELLING THE NUMBER OF STUDENTS CONNECTING TO LEARN IN AN AFTERNOON: SINCE EACH STUDENT STUDIES AT THEIR OWN PACE AND TIME, THEIR CONNECTION TIMES TO LEARN ARE INDEPENDENT FROM ONE ANOTHER, MAKING EACH EVENT INDEPENDENT.

STUDENT A

STUDENT B

STUDENT C



3:00PM

4:30PM

8:00PM

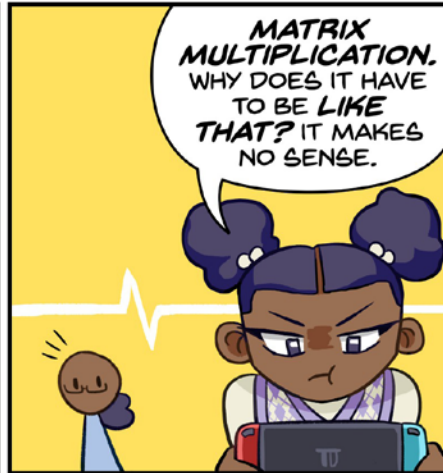
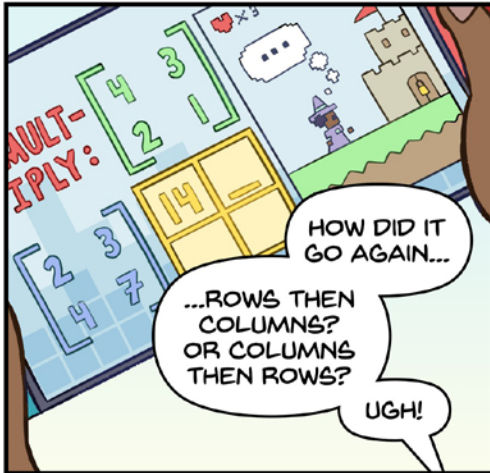
AND THAT'S IT! THAT SHOULD BE ALL THE BASIC DISTRIBUTIONS! THERE ARE A FEW MORE ADVANCED ONES, BUT THEY BUILD OFF THE BASIC ONES EXPLAINED HERE.

THANKS SO MUCH THEA, I THINK I UNDERSTAND MUCH BETTER NOW!

YOU KNOW, I FIND IT FUNNY THAT YOU KNOW THESE DISTRIBUTIONS SO WELL YET YOU CAN'T DISTRIBUTE YOUR TIME PROPERLY.

MATH 136: MATRIX MULTIPLICATION

STORY & ART BY CLARA XI



ONCE UPON A TIME, IN A MAGICAL LAND, THERE EXISTED **LINEAR MAPPINGS**. THESE POWERFUL ARTIFACTS COULD **TRANSFORM** VECTORS ACCORDING TO MYSTERIOUS RULES.

i.e.,

$$L\left(\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\right) = \begin{bmatrix} 4x_1 + 3x_2 \\ 2x_1 + x_2 \end{bmatrix}$$

AT FIRST, LITTLE WAS KNOWN ABOUT LINEAR MAPPINGS, OTHER THAN THAT THEY FOLLOWED THIS PROPERTY:

$$L(b\vec{x} + c\vec{y}) = bL(\vec{x}) + cL(\vec{y})$$

(where b, c are scalars)

IT WAS ALSO KNOWN THAT LINEAR MAPPINGS WERE **CLOSED** UNDER **COMPOSITION**.

i.e., $T \circ S(\vec{x}) = T(S(\vec{x}))$ is a linear mapping.

NOW, LINEAR MAPPINGS WERE DIFFICULT TO USE AND UNDERSTAND. THE PEOPLE OF THE LAND WANTED A WAY TO REPRESENT THEM **CONSISTENTLY**.

IN THE CASE OF COMPOSITION, PEOPLE WANTED TO DESCRIBE THE ACTION OF A COMPOSED LINEAR MAPPING AS A WHOLE, INSTEAD OF IN TWO PIECES.

A WISE WITCH REALIZED THAT, SINCE ANY VECTOR COULD BE WRITTEN AS A **LINEAR COMBINATION** OF **STANDARD BASIS VECTORS**...

$$\vec{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = x_1 \begin{bmatrix} 1 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$L(\vec{x}) = L\left(x_1 \begin{bmatrix} 1 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} 0 \\ 1 \end{bmatrix}\right) = x_1 L\left(\begin{bmatrix} 1 \\ 0 \end{bmatrix}\right) + x_2 L\left(\begin{bmatrix} 0 \\ 1 \end{bmatrix}\right) = x_1 \begin{bmatrix} 4 \\ 2 \end{bmatrix} + x_2 \begin{bmatrix} 3 \\ 1 \end{bmatrix}$$

...ANY LINEAR MAPPING COULD BE ENTIRELY DESCRIBED BY HOW IT TRANSFORMED THE STANDARD BASIS VECTORS.

MATH 136: MATRIX MULTIPLICATION

STORY & ART BY CLARA XI

THE WITCH INVENTED A STRUCTURE THAT WOULD CONTAIN THIS INFORMATION: **A MATRIX**. SUCH MATRICES MADE FROM THE STANDARD BASIS WERE CALLED **STANDARD MATRICES**.



$$\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix}$$

is the standard matrix of L .

THE WITCH DEFINED **MATRIX-VECTOR MULTIPLICATION** SO THAT THE **IMAGE** OF A VECTOR UNDER A LINEAR MAPPING WOULD ALWAYS EQUAL THE **PRODUCT** OF THE VECTOR WITH THE STANDARD MATRIX!

$$\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = x_1 \begin{bmatrix} 4 \\ 2 \end{bmatrix} + x_2 \begin{bmatrix} 3 \\ 1 \end{bmatrix} = L(\vec{x})$$

THERE WAS JUST ONE MORE THING THE WITCH NEEDED TO DO. SHE NEEDED TO FIGURE OUT HOW TO GET A STANDARD MATRIX FOR A COMPOSED LINEAR MAPPING.

Let $S, T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$, and let $\begin{bmatrix} s_1 & s_3 \\ s_2 & s_4 \end{bmatrix}, \begin{bmatrix} t_1 & t_3 \\ t_2 & t_4 \end{bmatrix}$ be their standard matrices.

$$\begin{aligned} T(S(\vec{x})) &= T\left(\begin{bmatrix} s_1 & s_3 \\ s_2 & s_4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\right) \\ &= T\left(x_1 \begin{bmatrix} s_1 \\ s_2 \end{bmatrix} + x_2 \begin{bmatrix} s_3 \\ s_4 \end{bmatrix}\right) \\ &= x_1 T\left(\begin{bmatrix} s_1 \\ s_2 \end{bmatrix}\right) + x_2 T\left(\begin{bmatrix} s_3 \\ s_4 \end{bmatrix}\right) \\ &= \begin{bmatrix} T\left(\begin{bmatrix} s_1 \\ s_2 \end{bmatrix}\right) & T\left(\begin{bmatrix} s_3 \\ s_4 \end{bmatrix}\right) \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \\ &= \begin{bmatrix} \begin{bmatrix} t_1 & t_3 \\ t_2 & t_4 \end{bmatrix} \begin{bmatrix} s_1 \\ s_2 \end{bmatrix} & \begin{bmatrix} t_1 & t_3 \\ t_2 & t_4 \end{bmatrix} \begin{bmatrix} s_3 \\ s_4 \end{bmatrix} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = T \circ S(\vec{x}) \end{aligned}$$

the standard matrix of $T \circ S$!

WORKING BACKWARDS, SHE DEvised THE PERFECT DEFINITION OF **MATRIX MULTIPLICATION** — ONE THAT MADE EVERYTHING FIT INTO PLACE!

THE PEOPLE OF THE LAND REJOICED IN THE WITCH'S INVENTION...



AND THEY ALL LIVED HAPPILY EVER AFTER.

SO MATRIX MULTIPLICATION REPRESENTS COMPOSITION? I GET IT NOW!



SUMMARY

Matrix-vector multiplication:
Let $A = [\vec{a}_1 \cdots \vec{a}_n] \in M_{m \times n}(\mathbb{R})$
 $\vec{x} = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix} \in \mathbb{R}^n$
 $A\vec{x} = x_1 \vec{a}_1 + \cdots + x_n \vec{a}_n$

Matrix multiplication:
Let $A \in M_{m \times n}(\mathbb{R})$
 $B = [\vec{b}_1 \cdots \vec{b}_p] \in M_{n \times p}(\mathbb{R})$
 $AB = [A\vec{b}_1 \cdots A\vec{b}_p]$



END.

mathNEWS MORE LIKE... UHHHHHH

FROM gridMASTER 148.3

You know when you, when the, uhhhh, you know, the, when it you know, does the, the do, the scooby dooby doo? And maybe even just a little bit of uhhhh, the when the... yes. (This is your brain when no **mathNEWS**, source: dude just trust me.)

I can arguably say that my university life has peaked. Not only did I make a **gridWORD** for you all, published in the #1 world ranked newspaper of all time (**mathNEWS**, duh), but there were also some solutions!

As far as answers to last week **gridQUESTION** ("Where did all the geese go?") went:

- smelly: "They are all busy with midterms"
- g00se: "They all went to QJD"

One of these is very heartbreaking, while the other is going to make me act up (you can figure out which is which).

Great work smelly! Awesome work on solving the **gridWORD**, and thanks for reminding me about the midterms coming soon. 🙏

This issue the **gridQUESTION** is going to be: "What food place, real or fictional is the best?" (I await Lazeez and Lobster Burger Bar answers).

This issue has a special **gridWORD** made by a special guest! Give it your best shot everyone! If you have a solution, email it to mathnews@gmail.com by 6 PM on March 14th with your name or moniker, and be sure to add your **gridQUESTION** answer! Alternatively, drop it off at MC3030, maybe along with some pie for Pi day? (haha jkjk only kidding..... unless???)

Wink wonk

ANIMALS OF A FEATHER

gridCOMMENT 148.4

There are a lot of words which, because of their convenient vowel structure, are common crossword answers. Seeing these words, if you've done enough crosswords, becomes gimmicky and ruins the fun. Below are a list of my 5 personal most-hated common crossword answers. I am proud to inform you that this week's **gridWORD** will not include any of them.

5. ACAI

This only gets used because of its vowel structure and all the clues are the same. They're all about a berry with a deep purple colour or a berry rich with antioxidants. The only reason it's not more hated is because it doesn't show up as much as the other entries on the list. C-

4. ACTI

What the hell is ACTI? You're completely right to think this. It is actually ACT/I as in Act One as in the first act of a play. I think you now understand why I hate this answer. It screams of "I needed something to fill the grid." No one uses this answer voluntarily. It can lead to some pretty clever clues. That's the only reason it's this high. D.

3. EWE

It's a cool word to see in a crossword. It's not that common in conversation. Then you see it 10 million times. And then another 10 million times. There's only really one way to clue it. And then the clues devolve into bad puns. It's the epitome of a cool word beaten to death by crossword writers. D-

2. ERA

This is probably the most common answer on the list. This is probably a function of the commonness of its letters. As far as three-letter words go, it probably has the most common letters someone could string together. This leads to crossword writers (cruciverbalists) using it all the time. Most clues for it usually just use its definition, which is incredibly boring. I once clued it with "Good Feelings, for one." This is very rare. D-

1. EON

This is OBJECTIVELY the worst crossword word. It shows up all the time, because of its unique EO beginning. It also only has three letters, which helps cruciverbalists use it to patch up corners without re-doing massive chunks of the grid. The only other relatively common answer with a similar structure is EOS. It has no interesting way to clue it. All clues take one of two forms: "A very long time period" or specific geological references. Even in the latter case, you can pretty much guess that the answer is EON without even really understanding the clue. It sucks. You win, EON. You get an F.

Marcellus Washburn III

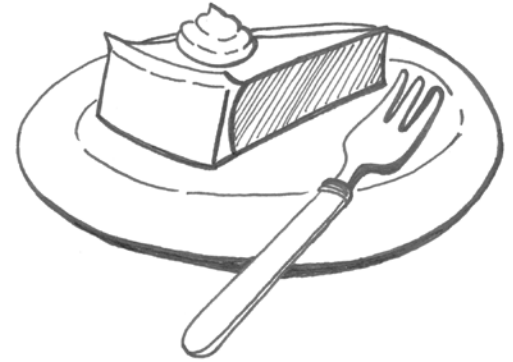
ACROSS

- 1. South Korean golfer K.J.
- 5. Miss America accessory
- 9. Character encoding standard
- 14. Hurt
- 15. Fallon took over hosting duties from him
- 16. Lindsay of "The Parent Trap"
- 17. Song in one of 49-down
- 18. Some CS TAs
- 19. Wooden board
- 20. How avians "of a feather" may travel
- 23. Shocking animal in the water
- 24. Killer of Cleopatra
- 25. Slammed into
- 28. Damage someone's reputation
- 30. British record label
- 32. Without ice, to hard liquor drinkers
- 33. Character played by 61-across
- 35. At least one Cretan, according to a paradox
- 37. Encryption system or Mandela's birthplace
- 38. How a mathNEWS reader celebrates good grades
- 42. Guevara of the Cuban Revolution
- 43. Lip
- 44. Engineering department (abbr.)
- 45. Opening word of a letter
- 47. As of now
- 48. Swedish currency
- 52. Calm down
- 54. Baby's scream
- 56. Housing for a pig
- 57. Aerial images
- 61. Reeves who played John Wick
- 63. Jessica of "Sin City" and "L.A.'s Finest"
- 64. Rowing team
- 65. One of three in a triptych
- 66. Victim of Cain
- 67. Every log has one?
- 68. Filthy
- 69. Uneven gymnastics apparatus
- 70. Business intelligence program (abbr.)

DOWN

- 1. Makes the body sore by irritation
- 2. New York City neighbourhood
- 3. Baltimore baseball player
- 4. Apple computer
- 5. There were two in a Thomas Young Experiment
- 6. Writer of fables
- 7. Grab, slangily
- 8. Watering tool
- 9. Type I error
- 10. Incredibly serious
- 11. People who work their magic?
- 12. Actor McKellen
- 13. Sign, slangily
- 21. People who ask to speak to managers
- 22. Prioritization process
- 26. With _____: Without effort
- 27. Stata file extension
- 29. De Armas of "Knives Out"
- 30. The rd. where a nightmare may take place
- 31. Old space station

- 34. Gave the green light
- 36. 1990 movie in a Sylvester Stallone franchise
- 38. Old-timey pronoun
- 39. Clothing accessory that keeps hair at bay
- 40. ANOVA table value
- 41. "_____ the ramparts": Lyrics to the Star-Spangled Banner
- 42. Music storage items
- 46. Poured from the heavens
- 49. La Traviata and Carmen
- 50. Most recent
- 51. Fill a bubble on a Scantron
- 53. Honestly and accurately
- 54. _____ Monday: November Sale
- 55. Non-imaginaries
- 58. Swedish car manufacturer
- 59. Island of Napoleon's exile
- 60. Cold War weapon
- 61. Typing stat (abbr.)
- 62. Water on the French riviera



1	2	3	4		5	6	7	8		9	10	11	12	13
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68							69					70		

Drop your gridWORD solutions off at MC 3030. And yes, we do award points for creativity.

SUN MAR 6

MON MAR 7

TUE MAR 8

WED MAR 9

THU MAR 10

FRI MAR 11

SAT MAR 12

International Women's Day ♀

Nominations for Senate by-election close

Cycle #2 employer rankings available @ 2 PM
Mario Day

Cycle #2 student rankings due @ 2 PM

SUN MAR 13

MON MAR 14

TUE MAR 15

WED MAR 16

THU MAR 17

FRI MAR 18

SAT MAR 19

mathNEWS 148.5 production night
Pi Day 🥧

Continuous round (Cycle #3+) begins
Ides of March 🗡️

Voting period for Senate by-election begins (vote at vote.wusa.ca)

St. Patrick's Day — will the famed Ezra parties return? 🍀
Voting period for Senate by-election ends

mathNEWS 148.5 released

LAST ISSUE'S gridSOLUTION

1	A	2	M	3	P					4	P	5	A	6	I	7	D		8	E	9	D	10	A	11	M		
12	N	D	A	13	S					14	A	O	R	T	A				15	V	I	D	A					
16	A	C	R	E						17	P	O	R	T	U	18	G	E	E	S	E							
		19	C	R	E	20	E	S	E						21	O	N	A	N	D								
			22	C	O	N	F	I	D	23	E				24	T	R	I										
				25	I	T	O	L	D						26	L	A	S	T	N	A	28	M	30	E			
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34	D	35	O	T	36	D	37	A	38	S	H				39	T	40	A	R	S	A	L	S					
41	P	R	O	E	M					42	U	43	S	O	R													
44	T	O	S	S	E	45	S	I	N						46	T	47	A	48	B	49	O	50	O				
						51	A	B	C						52	L	53	A	I	D	O	F	F					
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57	M	58	A	L	T	E	E	S	E	R	S										60	O	V	A	61	L		
62	I	R	A	E						63	A	S	C	O	T						64	N	I	L	E			
65	I	A	D	D						66	M	E	O	W											67	L	T	D

IS IT WEIRD TO EAT AVOCADOS BY THEMSELVES?

I have recently been called out by several people from my circle for eating an avocado straight up. Of course, I cut it open and ate out of it with a knife (I didn't want to waste utensils). I thought it was normal to eat them like that, you know, they're fruits! Btw, did you know that avocados are technically berries, and strawBERRIES are not? (Were berries always spelled like that? The word BERRIES looks unfamiliar in uppercase.) I love the unremarkable taste of avocados, they're so "whelming."

elaichi

[Editor's Note: Hey I eat avocados like that too lol]

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