"HOW DO YOU BEAT THE HEAT?"

THERE ARE OTHER THINGS YOU COULD BEAT, BUT THIS SEEMS TO BE THE MOST PERTINENT SUBJECT.

Welcome back, readers, to another iteration of **mathNEWS**.

This issue is quite a fine issue, despite my absence at the most recent production night. We have **mathASKS** and **profTHOUGHTS** featuring Prof. Dan Wolczuk, well-known for being a funny and engaging lecturer as well as his Ukranian dancing videos on YouTube.

In addition, there is a very helpful guide on the 2018 Ontario provincial election for those who may not have done all the research they meant to do before voting in the election next week. You *are* all voting, right? (Assuming that you're a legal resident of Ontario and registered to vote in your riding.) Though it may not feel like voting gives you much power, trust me, not voting would be exercising even less power.

"Now is usually the point where I start rambling." – swindlED

So I will follow in the spirit of rambling, and talk about unnecessary things that no one necessarily wants to read about!

This past weekend, a dear BC-based artist friend of mine visited Toronto to table and sell her wares at a certain gathering of Japanese animation enthusiasts. As thanks for my help in tabling, she drew me as a frog, a car, and an original character in the Sonic universe. The carsona has been included in this issue for reader perusal. For the others, visit the **mathNEWS** office! Or stay tuned for future issues of **mathNEWS**, as there's a good chance we'll be using them to fill space.

Other than that, midterm season is peeking around the corner once again. For those of you in co-op, that probably means interviews as well! I thought I had something to say about midterms and interview, but I really don't. Make sure you don't schedule your interview and your midterm at the same time, I guess? That's all I've really got.

Thanks for picking up this issue of **mathNEWS**! It will be instrumental in ensuring your future/continued success.

AC	I don't go outside.
I-USED-TO-PLAY-GTA	Use a baseball bat?
Samco	Eat cold things.
:3	ice cromsch
Centipo	Chill, and open a window.
Beyond Meta	By living in Canada.
waldo@<3.LE-GASP.ca	Spending as much time in MC-1006 as possible.
Various Pseudonyms	Controlled nuclear winter.
SIGSEGV	Go to my summer home in Alert.
tbdED	With a stick and extreme prejudice.
yclypED	Get some dirt on Dwayne Wade and blackmail him into throwing the game.
staplED	You don't. It beats YOU.
itorED	I tear off my outer layer of human skin to reveal the flesh beneath.
swindlED	Replace all my bones with ice bones. They're like ice cubes, but bone shaped.

itorED
*Editor, **mathNEWS***

ARTICLE OF THE ISSUE

This issue's article of the issue goes to Sanketh, for *Multiplying Two 2-Digit Numbers Using Only Three Digit Multiplications.* It's not easy getting actual math in **mathNEWS**, so props for that! Though I think it's the second issue in a row that we've gotten math, so maybe it's becoming more common than previously assumed...

One common section that the article of the issue will not be going to is the **profQUOTES**. Unfortunately, we are suffering from a severe deficit of **profQUOTES**. What does this mean? Are profs becoming less funny as time goes on? Are students less attentive and thus less likely to pay attention to the amusing things profs say in class? Is **mathNEWS** readership going down so drastically that readers who attend class no longer exist? We'll never know, I guess. That is, unless *YOU* (yes, you!) send in some **profQUOTES**. It'll be worth it, I swear.

itorED
*Editor, **mathNEWS***

mathNEWS is updating its privacy policy. The first rule of the policy is don't talk about the policy

MICHELLE ZHU, mathNEWS EDITOR FOR SPRING 2018
ALONG WITH ESTHER AHN, CLYDE BROWN, ANUJ OPAL AND HEATHER STONEHOUSE

mathASKS 137.2
FEATURING PROF. DAN WOLCZUK

ZETHAR: WHAT IS YOUR FAVOURITE TABLETOP ROLE-PLAYING GAME CHARACTER STORY?

You have to play in my D&D campaign to find out.

DIMINUITIVE REX: WOULD YOU EAT A BEE?

I try to avoid eating insects. In general, I have an understanding with bees. When we meet, they go about their business and I run away screaming.

SIGSEGV: WHAT'S THE HIGHEST NUMBER YOU CAN COUNT TO?

Depends on which language I am counting in. In English it is 2137 (That is the number where my brain asks 'why are you still counting?'). In Ukrainian it is 10. In Spanish it is 6 thanks to the song "Pretty Fly (for a white guy)", in most languages I can't get even get to 1. This makes me sad. Teach me how to say 1 in your native language.

VARIOUS PSEUDONYMS: WHAT'S THE MOST MEMORABLE CLASS YOU'VE EVER TAUGHT? (INDIVIDUAL LECTURE OR ENTIRE TERM)

It is hard to pick just one as there have been so many.

When I was a 2A student, I taught one lecture of a 2A CS course. The students in the class were in most of the other classes that I was taking that term. I will definitely never forget that experience.

Many years ago when class sizes were much smaller, I would always have one of my Spring Term lectures outside. Those were lots of fun.

OLIVER WOOD: HAS ANYONE EVER SAID THIS TO YOU? "HOW MUCH WOL WOULD A WOLCZUK CZUK IF A WOLCZUK COULD CZUK WOL?"

Yes. Although, my family's version is "How many walls could a wolczuk chuck if a wolczuk could chuck walls?"

STAPLED: IS IT EVER TOO LATE TO PICK UP SOME FORM OF DANCE AS AN ADULT?

It is never too late! I would recommend to everyone, as soon as they have time, to learn some form of dance. I am a particular fan of cultural dances (participate in your culture!), but also highly recommend Ballet to everyone. For that matter, I think it is never too late to learn anything that you have always wanted to learn. Having performed a lot on stage throughout my life definitely helped prepare me for teaching.

TBDED: IS IT TRUE THAT YOU'VE HAD TO STOP A FIST-FIGHT BETWEEN STUDENTS TRYING TO GET INTO YOUR SECTION OF LINEAR ALGEBRA?

No, I haven't… I hope that there has never been such a fist-fight. I wish that my classrooms were large enough that they could hold all the students who want to learn with me.

ITORED: HOW OFTEN DO YOU DANCE FOR YOUR STUDENTS NOWADAYS?

Unfortunately, never. :(My knees are in very bad shape. I often have trouble walking up and down stairs now. I will never be able to do my Ukrainian dancing again :(. Time to pick up a new hobby! Any suggestions?

SWINDLED: ARE THERE ANY COURSES YOU'D LIKE TO CREATE AT UW? A MATH-BASED DANCE COURSE PERHAPS?

Yes! Math 101 - The Mathematics of Dance. Definitely should be a required course :)

Other courses I would create: Learning How to Learn Math (would count as a communication course), Acting Lessons for Teachers, Foundations of Modern Math, Linear Algebra 3.

profQUOTES 137.2
THESE ARE THE ONLY TWO WE GOT, SO DON'T COMPLAIN UNLESS YOU'RE SENDING MORE IN YOURSELF.

MATH 138: PATRICK ROH

“ [talking about multivariable calculus] Don't try it. Be safe. I know you're in college and you want to experiment, but don't try anything dangerous. [silence] What are we talking about?

CS 116: JOHN AKINYEMI

“ [sees spider on wall] Alright, who wants to become Spiderman?

Solely to provoke an argument, I will say that I don't believe in infinite sets — they are merely convenient fictions.

PROF. DAVID WAGNER

TRANSLATING INSTRUCTORESE

profTHOUGHTS *137.2*

Many people recognize that Math is a language and that part of what we want to teach all of you in our classes is the vocabulary and grammar of Math. However, I have discovered that Math is not the only source of miscommunication between students and instructors. Instructors have their own language, which I call Instructorese. Here is a handy guide for translating what your instructor says to what they actually mean:

Recall: The following is knowledge which will be very helpful for what we are about to do. If you do not remember this (or were never taught), it is important that you take the time to review (learn) this as soon possible.

Clearly/obviously: I expect that most students in the class have the knowledge to justify this without difficulty. If this is not clear or obvious to you, you do not have to panic. But, as soon as possible, review the relevant content and make sure that you put in the effort to understand it.

This is important: This is really, really, REALLY important. We understand that it is extremely difficult to learn everything in the course perfectly, but this is an absolute must!

Are there any questions? Is there any part of the content that I just covered that you would like clarified or explained again? If so, please let me know which part as probably many other students in the class would also like me to go over that again. Note that if nobody answers, then I will have to assume that everyone understood my explanation.

Solve the problem: First, attempt to solve the problem on your own like you will have to on an exam in order to test your current level of understanding of the content. If you are not able to solve the problem or are not confident in your solution, then use the various resources that are available (lecture notes, textbook, discussion forums, your peers, tutorial centre, etc.) to help you learn and understand the content so that you can apply it not only for the rest of this course, but also in future courses and beyond. Ensure that you are focusing on the thought process of how to come up with a solution and on the method being used in the solution so that you can use both of these to help you solve future problems.

I'll leave this as an exercise: I am leaving this for you to do since math is best learned by doing rather than watching. Moreover, I feel that this exercise will help you understand the content and succeed in this course. You should solve this problem.

In today's lecture: I feel it is beneficial for you to learn everything I am going to do in this class, and, unless I specify otherwise, it could appear on the exam.

In the next lecture: This is what we are going to do in the next lecture. It would be a great idea for you to preview this material before the next lecture.

The next assignment is posted: You should start to solve the problems on the assignment as soon as possible. There are many good reasons for this. One reason is that it gives you longer to work through the problems, which means you will learn more. Another reason is that if you manage to finish early, you will have more time to do other fun things like working on other assignments, studying, or doing laundry.

Solutions are now posted: Regardless of your score, you should compare all of your solutions to the posted solutions. If any of your solutions is incorrect, then take the time to understand why it was incorrect, to think about why you made that mistake, and to use the available resources to correct that mistake so that you will not make the same one (or similar ones) again. For each of your solutions that is correct, note if there are any differences between it and the posted solution. Also, take note of the posted solutions as they indicate my expectations of you. If you have questions about the solutions, please ask me.

Thanks to Ryan Trelford, Laura Bumbulis, and Aga Wolczuk for their help in compiling this.

Someone should write a document for instructors to translate Studentese. Right now, the only one I'm sure of is:

Will that be on the test? I would be really happy if you put this on the test. The harder the question the better.

Prof. Dan Wolczuk

N THINGS I AM NOT ALLOWED TO LICK

- The walls of MC
- A goose
- ~~Popsicles~~
- The surface of the sun
- ~~My roommate~~
- My other roommate
- The copy of **mathNEWS** you are currently holding
- You?

Diminutive Rex

THE 2018 ONTARIO ELECTION: A GUIDE FOR PEOPLE WHO AREN'T POLITICS JUNKIES

It's election season in Ontario! That's right—for the next month we all get to "enjoy" seeing differently-coloured lawn signs on every street corner, strangers knocking on our doors now and again asking for our votes, scary-sounding TV ads during the Stanley Cup playoffs, and the same three (or four) faces in the all papers every single day. Democracy in action! (Hooray?)

Maybe you're a new voter. Maybe you are someone who doesn't normally pay attention to politics, wants to engage in the election, but don't know where or how to start. Or maybe you just think politics is either boring or disappointing, and so you've tuned out. **This piece is for all of you.** In the rest of this piece, I will—hopefully in a non-partisan and fact-focused way—give you a straightforward rundown as to what is happening in Ontario right now, why it matters, who the key players are, and how to make a plan to vote. I will also provide links to resources where you can find out more.

OKAY—WHAT IS GOING ON IN ONTARIO RIGHT NOW?

On Tuesday, May 8th, the Lieutenant Governor of Ontario (Her Honour the Honourable Elizabeth Dowdeswell O.C. O.Ont), acting on the advice of the Premier, put all 107 of Ontario's elected representatives out of a job. That is to say, she *dissolved* the Legislative Assembly, ending its life and the terms of office of its members.

The next day, as required by the Ontario Elections Act after dissolution, Her Honour issued *writs of election* for the 124 electoral districts that will choose representatives for the 42nd Parliament of Ontario. Election day is **June 7th, 2018**. The representatives we (the voters) elect will become legislators at Queen's Park in Toronto, and as such, they will be called upon to supply the Ontario Government with money, study & implement the Government's legislative agenda, and will also bring forward bills of their own (private member's bills) that could eventually become law. More importantly, in our system of responsible government, *the Premier and Executive Council who form the Government are chosen from the elected MPPs in the legislature based on their ability to command the "confidence" of a majority of the elected representatives there.* **Usually**, that means the leader of the party with the most seats becomes Premier.

So the next few weeks could cause the current Government to fall and give rise to a new one, or re-affirm its power, and will almost certainly alter the policy priorities that affect all our day-to-day lives.

AND THIS... MATTERS?

Canada's federal system means we enjoy two *co-equal* orders of government, which cannot directly interfere with each other. The provincial government has direct authority over:

- Healthcare
- Education (primary, secondary, and post-secondary)
- Municipal Government
- Labour & Employment Standards
- Energy
- Natural Resource Development (shared with the federal gov't)
- Transportation & Traffic Laws
- Child Welfare
- Most policing

…And more! That's not even a complete list (but it's a pretty big one).

Tearing your hair out every time you get a hydro bill? Living in a rural community and wondering why there are no hospitals near you? Sick of 15-hour waits in the emergency room? Concerned about the new $14 minimum wage? Trying to find an affordable place to rent in Toronto and coming up short? *All of these are things the provincial government has a hand in, and they are all election issues.* The provincial government deals with services—stuff you see and feel in your every day life. It also charges taxes—on corporate income, personal income, and on the sale of goods—to pay for those services. For that reason, who gets to hold the highest offices in government matters, and voting is as much in your interest as it is a hard-fought and dearly held method of civic participation.

BUT THERE'S MORE. The election isn't just about who forms government. *Who your elected Member of Provincial Parliament (MPP) is also affects you!* Aside from being the link between the people in your local area ("riding") and the Legislative Assembly & Government, a good MPP can make the difference between being able to navigate government resources, and being frustrated by them. When you're confused by something on your tax bill, or if you've lost your health card & don't know how to go about getting a new one, or you need help applying for social assistance, your MPP (and their office staff) is your first and best point of contact. Good MPPs can also become champions for important issues not big enough (or too local) to make it onto the Government's agenda, and can play a strong role in holding the Government to account for those issues in the legislature, sometimes even implementing change through a private member's bill.

In short, **make a plan now to vote on June 7th or earlier.** I'll talk about how to do that shortly.

WHO ARE THE BIG PLAYERS IN THIS ELECTION?

MPPs, candidates, and some politically-active voters tend to organize themselves into formal groups, called "parties" based on shared ideological & practical values. Parties have become a major part of our election systems, and it is useful to recognize the "major" ones and their brands before you go out and vote.

THE ONTARIO LIBERAL PARTY (OLP, "THE GRITS")

- *Seats in the Legislature at Dissolution:* $55/107$ (58 won in 2014)

- *Leader:* The Honourable Kathleen Wynne, Premier of Ontario (Re-election candidate for Don Valley West)
- *About this Party:* The Grits have held power in Ontario for 15 consecutive years now, though Kathleen Wynne has only been Premier since 2013. Like any long-serving government, they have had to weather their fair share of scandals and criticisms over the years, especially since the memory of the government they replaced grows more distant. In order to maintain power this time around, they will need to overcome voters' antipathy, plus their opponents' claims that they have become corrupt and out-of-touch, by high-lighting the popular elements of their record and championing fresh ideas.

THE PROGRESSIVE CONSERVATIVE PARTY OF ONTARIO (PCPO, "THE TORIES")

- *Seats in the Legislature at Dissolution:* 27 (28 won in 2014)
- *Leader:* Doug Ford (Candidate for Etobicoke North)
- *About this Party:* Considering that the polls currently favour them forming the next government, the Tories have had a rough go of it lately. Former leader Patrick Brown was dethroned in spectacular fashion just a few months ago, and the rapid-fire leadership race that followed chose a non-MPP—former Toronto City Councillor Doug Ford (the brother of the late former Toronto Mayor Rob Ford)—to be the party's new chief. The PCPO are hoping that its promises to cut corporate and personal income taxes, invest in mental health & public transit, and scrap the Liberal "cap-and-trade" carbon program will resonate with voters in spite of accusations from their opponents that Ford is regressive and unqualified to lead.

THE ONTARIO NEW DEMOCRATIC PARTY (ONDP)

- *Seats in the Legislature at Dissolution:* 18 (21 won in 2014)
- *Leader:* Andrea Horwath (Re-election candidate for Hamilton Centre)
- **About this Party:** This is probably Andrea Horwath's do-or-die moment in Ontario politics. The longest-serving major party leader in the legislature (this will be her third general election since becoming ONDP leader in 2009), after being widely criticized by prominent members of her own party for her role in triggering the 2014 election, the onus is now on her to dramatically increase her party's seat count (either becoming Premier herself, or the king-maker in a minority government), lest she step down. To win, she will need to convince voters that she is not Kathleen Wynne, and present a progressive platform that is more appealing than the Grits' brand of "activist government," while overcoming her opponents'

accusations that her plans will break the bank & slow economic growth.

SOME OTHER PARTIES YOU MIGHT HAVE HEARD ABOUT:
The **Trillium Party of Ontario** is a relatively new party which gained its first-ever (and only) seat in the legislature last year, when MPP Jack MacLaren was kicked out of the Tory caucus (the word given to the collection of elected MPPs holding official membership in the same party), and went in search of a new ideological home. Led by Bob Yaciuk (candidate for Newmarket-Aurora), the Trillium Party professes a generally populist-conservative platform, and is clearly hoping to retain their existing seat and gain a few more on the favour of right-wing voters disillusioned with the PCPO.

The **Green Party of Ontario** have never won a seat in a provincial election, though they are usually the default runners-up to the candidates for each of the three major parties, and the "Green Party" brand is know well-known federally and in other countries around the world. Electoral success for the Greens will require long-time party leader Mike Schreiner (candidate for Guelph) to leverage his inclusion in a number of leader's debates to position his party as a sensible alternative to the status quo, not just on environmental issues, but on a wide range of other matters as well.

IF WE HAVE NO MPPS RIGHT NOW, WHO IS OUR PREMIER DURING THE ELECTION CAMPAIGN?
Kathleen Wynne remains in the Premier's Office throughout the election, just as she has since February 11th, 2013. She will continue to hold that office until she resigns, or until the Lieutenant Governor sees fit to dismiss her (which would usually require her to lose a confidence vote in the legislature, or refuse to recall the legislature promptly after an election). However, she and her cabinet will be restricted by a consti-tutional convention called the *caretaker convention*, which, in essence (it is unwritten) requires the Government to exercise restraint from the moment the legislature is dissolved—no new funding can be approved, no new regulations can be issued, no contracts can be signed or appointments can be made. If it is absolutely necessary to act in a way that could bind a future government, it is expected that the Premier will attempt to consult with the leaders of the other major parties first. *The caretaker period ends when an election result is delivered that clearly returns an incumbent Government, or when a new Government is sworn in.* Read more about the role of the non-partisan Ontario Public Service in maintaining the caretaker convention here: https://www.ontario.ca/page/news-secretary#2018-february-28

HOW DO I VOTE?
Voting is super-easy, and you can do it as long as you are a Canadian citizen living in Ontario. Elections Ontario provides a number of different ways to vote:

- In-person at your local polling station on June 7th
- In-person at your local advance polling station on May 26th-May 30th

- In-person at your local Returning Office anytime between now and June 6th
- In-person, by mail, or by home visit (through the hospital program) by special ballot anytime before election day.

You are probably on the voters list already. Elections Ontario maintains an electronic list which you can check online to verify you are on the voters list (you can register if you are not). **You can still vote even if you are not registered on the voters' list for your riding on Election Day.**

Your employer is legally required to provide you with three consecutive hours in which you can go vote on election day. There are (very basic) ID requirements, but if you forget ID it is possible to have someone vouch for you. **Do your research, and make a plan to vote before or on election day!**

Was I Ever a Mathie??

LESS IS MORE

Suppose that you have a text file to read. How would you do it?

Well, if this was after 1978, you might use a terminal pager called more. more is a terminal pager for unix, and the description of the program is "file perusal filter for crt viewing".

So what does the program do? Well, when you call the more [options] file, it opens the first page of the file and allows you to read it. You can press SPACE or z to scroll a page. You can press d to scroll 11 lines, and RETURN to scroll 1 line. You can also do simple searches with /pattern.

more did not come without some drawbacks. There is no scrolling backwards (in the original versions). more also needed to load the entire file before the program displayed the first page.

It seems to be quite a useful program, since sometimes you may wish to read a file. But what if…you wanted…something…more?

Enter less. A program that is described as "opposite of more". But less is more than more. It can do everything that more can do and more. More features, more options, more portability. More importantly, it does not need to load the entire file before starting up anymore. less was written in 1983 to 1985, made to be more than more.

In closing, if you are working in the terminal of a unix-like system, use less. It's really more.

quiz

TOTAL WAR: ARENA
WORLD OF TOTAL WAR

The Total War series of strategy games are known for their 'big picture' turn-based campaign maps combined with real-time battles when armies bump into each other, allowing a single player to manage an empire. Today, though, there is Total War: Arena, a game that only has the real-time tactical combat side of Total War, and made as a 10v10 MOBA by wargaming.net — the folks who made World of Tanks.

This large number of players per team wasn't possible in previous total war games since one player had 12-20 units to control at once, each one made up of dozens or hundreds of individuals soldiers. This caused processing problems for some in only a 2v2 match. It is possible now because (on top of better tech being more common) individual players are restricted to exactly 3 units and one attached commander, each of which has 2-4 abilities to manage. This gives you the ability to easily micromanage your troops. And micromanage you will, since basic concepts present in the Total War series are still here such as unit morale, unit facing, and the rock-paper-scissors of the different infantry, missile, and cavalry units.

So watch your flanks, be prepared to give ground, or rush in to support a friendly force — because while it takes a long time to grind down units in a fair fight, you should never expect or give one yourself. Hit those pikemen with archers, overrun those catapults with cavalry that you snuck through a forest, flank those infantry with whatever you have and cut-off their retreat, cutting them down as they rout. It is most of the fun of a Total War battle, but one where you can't afford to lose any units.

Four factions are in so far: Rome, Greece, Carthage, and Gaulic Barbarians, each of which have different unit and commander specializations. For example, there is a Greek commander that is meant for turning spearmen into an immovable wall of defense, or a Roman commander meant for keeping heavy infantry moving forward with charges and testudo shield formations.

If you are interested the open beta is currently up and surprisingly good, with all the problems that it had when I first looked being fixed within a month. Just be aware that it is a wargaming.net game, with the usual tier-progression system that they love to include, so don't expect to have access to everything from the very start.

Now grab a friend to watch you flank, and go earn some victories!

Soviet Canadian

AREA MAN CONVINCES WOMAN TO SLEEP WITH HIM BY PRETENDING TO BE 400-PIECE SYMPHONY ORCHESTRA

In what is considered an unprecedented and absolutely legendary move, area man convinced a local woman to engage in consensual intercourse with what she believed to be a 400-piece symphony orchestra. It was not until later when a mutual friend identified the man as actually an individual and not a large collection of musically talented entourage.

Sources say that the two met at a concert hall where the man pretended to be a large ensemble of instrumentalists, vocalists, and a conductor working in unison to perform Mozart's 42nd Symphony, also known as The Answer. The area man admitted that the entire show was an elaborate ruse to gain the attention of a woman that he met during an elective course earlier in the term. He found her fascinating and wanted to get to know her better, so he offered her a free backstage tour at the end of the show. In an expected twist, she accepted.

However impressed she was with the show, upon discovering that she had not shared an intimate night with a like-minded symphonic crew, but just an individual posing as one, she couldn't help but feel betrayed. "It's really shocking because I felt such a huge connection with 400 musicians during that night only to find out that it was a lie and it was really just one guy pretending to be a bunch of violinists, cellists, didgeridooists… " She recounted the fluttering in her heart that night which was reflected by the woodwind section's upbeat rendition of the 69th movement before the climatic 70th. "I just wish he trusted me enough to show me who he was first. Like, I have no idea if he's even a conductor or not."

The area man took the criticism to heart, and offered to do the gentlemanly thing and take her out on their first official date next week. He promises a special evening wherein he will impress her with his wit and charm, and by emulating an entire Nutcracker performance in hopes that she'll return the favour later.

Pleiades

DEFINING A GENRE

2 years ago Pokémon Go took the world by storm, but it's just now that some competitors are truly emerging onto the market. This raises an issue: despite the fact that the game has existed for 2 years, and it's predecessor Ingress even longer, there is no agreed upon name for this category of games.

According to Wikipedia, Pokemon Go is a Location Based or Location Enabled Augmented Reality Game. We'll go for Location Enabled Augmented Reality or LEAR, as it's a nice pronounceable acronym.

Why even care about this? I just don't want my favourite genre of game to be described with an alphabet soup of a name like ARMMORPG. Also, someone else wrote an article about the election, so I decided to write about the second most important issue we're currently facing.

Why is calling it an ARG not sufficient? That's about as descriptive as describing something as a PC game. Not all ARGs necessarily involve walking and exploring the world, and that's really the specific kind of ARG I am interested in. I want to be able to tell people how much I love to play LEARs without having to define my terms at the start of each conversation. And while I love Pokémon Go, and think it's an awesome game, I am really hyped to see what other LEARs are going to do. There is so much potential.

Pokémon Go when it first came out was a really really simple game. Yet despite the fact that it barely had any features, it became a massive phenomenon. While newer LEARs won't have the same novelty factor that PoGo had, there is still a lot of room for growth.

And so, to ensure that my acronym has some staying power, I will be writing reviews each issue about a specific LEAR and my thoughts on it. Here is a short preview of all the games that will soon be hitting the market.

CURRENTLY OUT:

- Ingress
- Pokémon Go
- Draconius Go

OPEN BETA:

- Jurassic World Alive
- Delta T
- Maguss

UPCOMING RELEASES:

- Ingress Prime
- Selfie Go[1]
- Clash & Go
- The Walking Dead Our World
- GhostBusters World
- Harry Potter Wizard Unite

Beyond Meta

1. It's even worse than it sounds. Selfie Go is going to be something.

A RANSOM NOTE TO DIE FOR

To the course administrators of STAT 333, I have a message for you.

Last week, during our tutorial, I kept one of the dice provided for use in the game-based activity. I would like to apologize for this heinous act and return the die, but I thought of something much more devious to do instead.

Starting on the day of publication of this article, June 1st, 2018, I will roll the die once per day at midnight, and I will continue to do so until the day the ransom is paid. What ransom, you ask? X, where X is the sum of all the die rolls up to the time of payment.

While you discuss your options and attempt to track me down, I would also like to take this opportunity to pose and answer the following question: what is the expected ransom payment?

Before I can begin, I have to lay out some assumptions:

- The random variable N describes the number of days until the ransom is paid. I will assume it is a proper waiting time random variable, meaning that, eventually, the ransom will be paid.
- The die is fair, so the die rolls for each day $i = 1, 2, ..., N$ will be discrete $U_i \sim \text{Uniform} \{1,...,6\}$ random variables, mutually independent of each other.
- The number of days it takes to pay the ransom is not affected by any of the die rolls individually (i.e. the variables are independent).

With these assumptions laid out, we can begin by looking at the following expectation, the expected value of X given that N is some possible value n.

$$E[X|N=n]$$

Substituting the definition of X, we get:

$$E[X|N=n] = E[U_1 + . . . + U_N|N=n]$$

Now, since the value of N is set at n by the condition on our expectation, and because the Ui's are independent of N, we get this:

$$E[X|N=n] = E[U_1 + . . . + U_n]$$

Finally, using the linear nature of expectation and the identical distributions of the die rolls, we have:

$$E[X|N=n] = E[U_1] + . . . + E[U_n] = nE[U_1]$$

Since the mean value of a single die roll is 3.5, this results in a final value of 3.5n. However, this only tells us the expected ransom payment if we know that $N = n$. So, we need one more tool: double averaging. Feel free to try the proof on your own or look it up, but the result we are interested in here is, for two random variables Y and Z:

$$E[Y] = E[E[Y|Z]]$$

So in our example,

$$E[X] = E[E[X|N]] = E[3.5N]$$

Once again using the linear nature of expectation, we have:

$$E[X] = 3.5E[N]$$

So the final result we see is that the expected ransom payment is 3.5 times the expected number of days. If we assume that N follows a geometric distribution with probability of payment on any given day of ¼, this would give us an expected ransom payment of $14 for the die, however any proper waiting time random variable would suffice.

I look forward to your response, course administrators of STAT 333. May the odds be ever in your favour.

New&Confused

INTRODUCTION TO SET THEORY

Set is the Egyptian god of the desert. The desert, being full of sand, is a non-empty Set. Set is also what people do in Yu-Gi-Oh when they want to place a card face-down. This children's card game also heavily draws inspiration from other Egyptian gods such as Osiris, god of the afterlife; Ra, god of the sun; and Obelisk the Tormentor, god of torment. One god featured in particular is Exodia, the Forbidden One. If a player collects all five pieces of Exodia in their hand, they win the children's card game.

Both players draw 5 cards at the beginning of a game, and the "Forbidden One" cards are limited to one each per deck. Therefore, the probability of drawing Exodia on your first turn, assuming the minimum deck size of 40 cards, is 1/ (40 C 5) or about 0.000152%. This increases if the player actually knows how to play the game and uses card effects to draw more cards from their deck, or decreases if the player decides to have a larger deck (up to a maximum of 60).

The probability of drawing the final piece given you already have the other four in your hand, and given you have a piece of jewelry that contains the spirit of an ancient Pharaoh, is 100%. The proof for this statement is too large to fit in the remaining space for this article.

AC

MULTIPLYING TWO 2-DIGIT NUMBERS USING ONLY THREE DIGIT MULTIPLICATIONS

Most computer scientists (or other people in general!) do not care about the computational complexity of multiplying two numbers---they think that it is trivial or a hardware issue. But the advent of the modern cryptosystem changed this by requiring multiplication of huge numbers. RSA, for instance, requires multiplication of 2048-bit numbers, and post-quantum RSA schemes like the one recently proposed by Bernstein et al.[1] require a 1-terabyte key consisting of 4096-bit primes!

The grade school algorithm for multiplying two 2-digit numbers requires four multiplications; that is, for a product

```
  a₁ a₂
× b₁ b₂
```

we need to compute $a_1 b_1$, $a_1 b_2$, $a_2 b_1$, and $a_2 b_2$. This is four digit multiplications. In this post, as the title claims, I will show you a way of doing this which only requires three multiplications. But, first, let us get a little abstract and consider 2-digit numbers over an arbitrary base m. Let

```
a = a₁m + a₂
b = b₁m + b₂
```

KARATSUBA'S ALGORITHM

This algorithm is due (analytic) number theorist Anatoly Karatsuba. You might know him from his short classic Basic Analytic Number Theory[2]. If you are interested in computational complexity theory, I also highly recommend his survey in the Proceedings of the Steklov Institute of Mathematics[3].

In 1960, Andrey Kolmogorov organized a seminar at the Moscow State University, where he stated a conjecture of his that the above grade-school algorithm is asymptotically optimal or that to multiply two n-digit numbers, one needs $\Omega(n^2)$ ementary operations. Within the week, Karatsuba, then a student, found an algorithm which multiplies two n-digit numbers with $O(n^{1.58})$\$ elementary operations. Then something weird happened, Kolmogorov published Karatsuba's algorithm!? Well, he credited it to him but WHAT!? Apparently, Karatsuba apparently only knew of the publication when he got a reprint!

I cannot blame Kolmogorov too much, as you will see, this is a really cute algorithm. Before I introduce the algorithm, consider this use case---you wanna multiply two \$2048\$-bit numbers (this is common when you are working with, say, RSA). Then the grade-school algorithm needs about **4,194,304** elementary operations, while Karatsuba's algorithm only

needs about **177,147** elementary operations! This is clearly a noticeable improvement for real-world tasks.

THE SIMPLE CASE

```
Compute F = a₁b₁
Compute G = a₂b₂
Compute H = (a₁+a₂)(b₁+b₂)
Compute K = H − F − G = a₁b₂ + a₂b₁
Compute Fm² + Km + G = a₁b₁m² + (a₁b₂ + a₂b₁)m + a₂b₂ = a·b
```

But there is a problem with the above procedure - $(a_1 + a_2)$ or $(b_1 + b_2)$ might overflow. You can easily remedy this by modifying the algorithm to compute

```
H' = (a₁−a₂)(b₁−b₂)
K' = H' + F + G = a·b
```

To make it clear, let's do an example. Suppose we want to multiply 23 and 45. Compute

```
         F = 2·4                = 8
         G = 3·5                = 15
         H = (2 + 3)(4 + 5)     = 45
         K = 45 − 8 − 15        = 22
Fm² + Km + G = 8·100 + 24·10 + 15    = 1035
```

which is the right answer!

Note that the last step is not multiplication but shifted addition. (Multiplication by 100 is adding two zeros to the end.)

Now let's do it again, and again, and again,...

The above algorithm works for any 2-digit number over any base m, so for a large number we can recursively apply it.

To multiply two n-bit numbers we can keep breaking it into $n/2$ chunks and applying Karatsuba's algorithm to it. (Computer scientists like to call this divide and conquer.) For simplicity suppose that $n = 2^k$ for some k. Then the number of digit multiplications we need to do is 3^k, which is $n^{1.58}$.

Further Reading: De, Anindya, Piyush P. Kurur, Chandan Saha, and Ramprasad Saptharishi. "Fast integer multiplication using modular arithmetic." SIAM Journal on Computing 42, no. 2 (2013): 685-699.

Sanketh

1. Bernstein, Daniel J., Nadia Heninger, Paul Lou, and Luke Valenta. "Post-quantum RSA." In International Workshop on Post-Quantum Cryptography, pp. 311-329. Springer, Cham, 2017.
2. Karatsuba, Anatolij A. and Melvyn B. Nathanson. Basic analytic number theory. Springer Berlin, 1993.
3. Karatsuba, ANATOLII ALEXEEVICH. "The complexity of computations." Proceedings of the Steklov Institute of Mathematics-Interperiodica Translation 211 (1995): 169-183.

YCLEPED, SIGNING ON

In Zethar's final **gridCOMMENT** last issue, he said "They've found someone to oust me from this iron throne and actually make good crosswords with a consistent theme." I remember reading that for the first time and thinking, "Oh cool, I wonder who it is. I guess I'm off the hook for making puzzles this term, hurray!"

That was a simpler time.

Frankly, I don't know if my puzzles will be good... but they will be puzzles. Probably. Moreover I don't know if I would have agreed to this task if I knew I had to sit on TV's most uncomfortable looking chair. But I digress...

This week's puzzle has a math theme. Original, right? But the mathy answers are hidden behind non-mathy clues. So maybe that helps. At (18-down) rate, I hope you enjoy. I'll be the first to admit it's clunky. But stick with me kids, I'll get the hang of it soon ;)

Last issue's **gridQUESTION** was "What is some advice you would like to offer the incoming **gridMASTER**?" (a question I did not know I was the object of until some time after I first read it). There were two correct puzzle submissions. The first one is from Joseph, who answers "Don't drink and derive." I actually did write an algebra exam in an inebriated state during my wayward youth, but never a calculus exam. So I have yet to drink and derive, and I intend to keep it that way! But my favourite answer (and thus the winner) comes from the basically-named 'e', who advises me to "Have fun! You're volunteering after all." I like it because it's the exact kind of answer I was going to write before I realized I'd be writing it to myself! e, you can come by the **mathNEWS** office MC3038 to collect your prize.

As for this issue, the following rules apply (with thanks to my predecessor Zethar, a man I've never met or corresponded with):

- Solvers to the issue's **gridWORD** may elect to submit their solution to **mathNEWS**, wherein the most correct solution shall be awarded a prize by the **gridMASTER**.
- For a solution to be eligible, it must be submitted either physically to the **BLACK BOX** located outside the Math C&D, or electronically to mathnews@gmail.com with names of solvers (and optionally, a moniker of which the solution is to be credited) by 1800 hrs on the date of the production night of the next issue in the term (in this case, June 11th, 2018), provided it exists.
- In the event of a tie for most correct, the **gridMASTER** makes a selection among the answers which are most correct, of which the traditional method is the **gridMASTER**'s favourite answer to their **gridQUESTION** of the issue. (Traditionally, it is de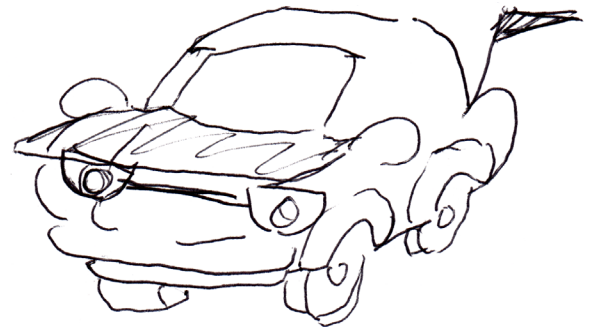scribed as "funniest" but in practice, it's "whatever the **gridMASTER** likes the most" so in the interest of transparency…)
- If one is listed as having won the prize of the issue, one may drop by the **mathNEWS** office to pick up the prize. Please bring your Watcard or some other form of identification which matches the name of the submission (which might be different from the moniker it is credited to—it gets sorted out via administrative magic)

Hopefully I'll be back next time. That is, unless the puzzlers revolt, and my fellow editors relegate me back to making more papier-mâché sculptures out of back issues. Just in case I do come back, I better write a **gridQUESTION** (in case of a tie): "If **mathNEWS** were a political party, who would be running for us in the provincial election?"

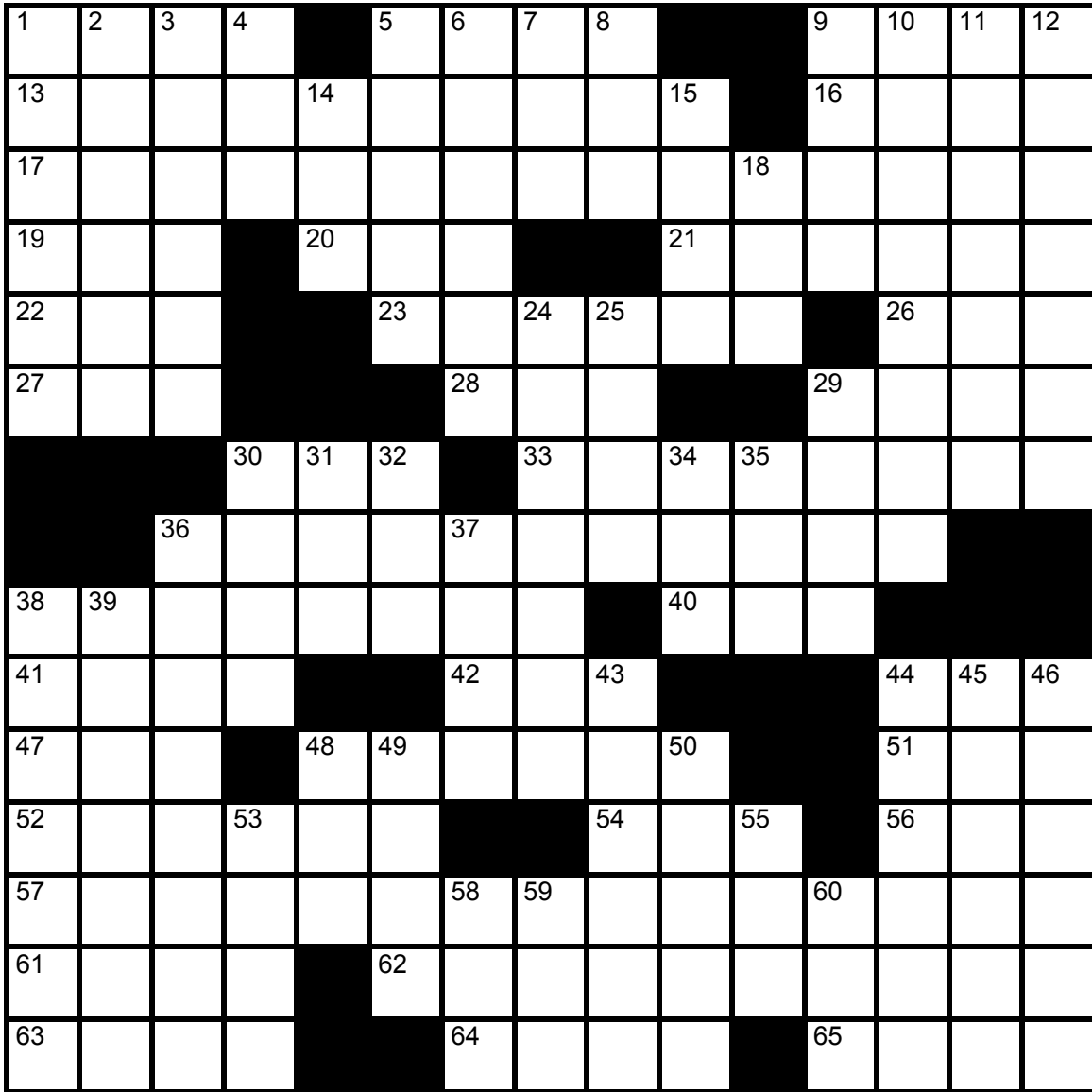Bye for now!

yclepED
gridMASTER *v137i2-???*

GRIDWORD

ACROSS

1 (With -gate) to repeal a law
5 Additive identity
9 Halifax water, for short
13 "I'm a doctor, look at meeeee!"
16 What the postman brings
17 High pressure dinner bell on the ranch
19 It might cause a blackout
20 Tear
21 Oxygen/Nitrogen/Tin/Lanthanum
22 ___ Speedwagon
23 Happily
26 Small town between London and Cambridge
27 The time in Waterloo these days
28 Hubbub
29 A Romanian hero
30 Soldiers
33 An association of perjurers
36 According to instructions
38 Group of chef Childs' devotees
40 Ad ___
41 ____ Major (or Minor)
42 Zollinger-Ellison Syndrome, for short
44 Popular online image format
47 Tiny vegetable
48 Marshes
51 Literally the letters "HVR" (is it obvious this is my first time doing this?)
52 The crew that fixes your work computer
54 You have a right one ... (see 14 down)
56 First lady
57 Kind of a jerk
61 Historical periods
62 "All right, Mr. DeMille, I'm Ready for my close-up." film
63 Rave
64 Art school in Providence
65 Monkee ____ Jones

DOWN

1 Current
2 What Scotty did up
3 Be someone's gym buddy a 2nd time
4 A great place to see space rocks in Toronto
5 Woody Allen mockumentary
6 A laser manufacturer
7 Q _ _ _ U
8 Technology that makes Scantron possible
9 A great place to see butterflies in East Texas
10 Mythical cycle in Norse mythology (alt. sp.)
11 _____ marry me? (2 wds)
12 Grey skies are gonna _____ (2 wds.)
14 ... and a left one (see 54 across)
15 Pair of -OH groups
18 Even a little bit of
24 Appointed by the court, as a guardian
25 Just __ __!
29 Ivanka's bro
30 A kind of neural tissue
31 "Hometown Proud" grocery chain
32 Help!
34 "I don't know..."
35 Monsanto specialty
36 Type of police dog
37 ____ Shah Pahlevi
38 Planet with a string of pearls
39 Your cat's might be infected
43 90's vocal group The _____ Girls, known for their skill at extracting ore
44 Aussie lassie
45 2010 indie platformer starring Captain Viridian
46 Smurf with a chef's hat on
48 Blue
49 Items that were conspicuously hard to find in 2003
50 Economized
53 ____while (former)
55 Pixar's Remy, for example
58 Germ., Fr., Bulg., etc.
59 First nurse, in a Roman manner of saying
60 My status as **gridMASTER** for the next issue

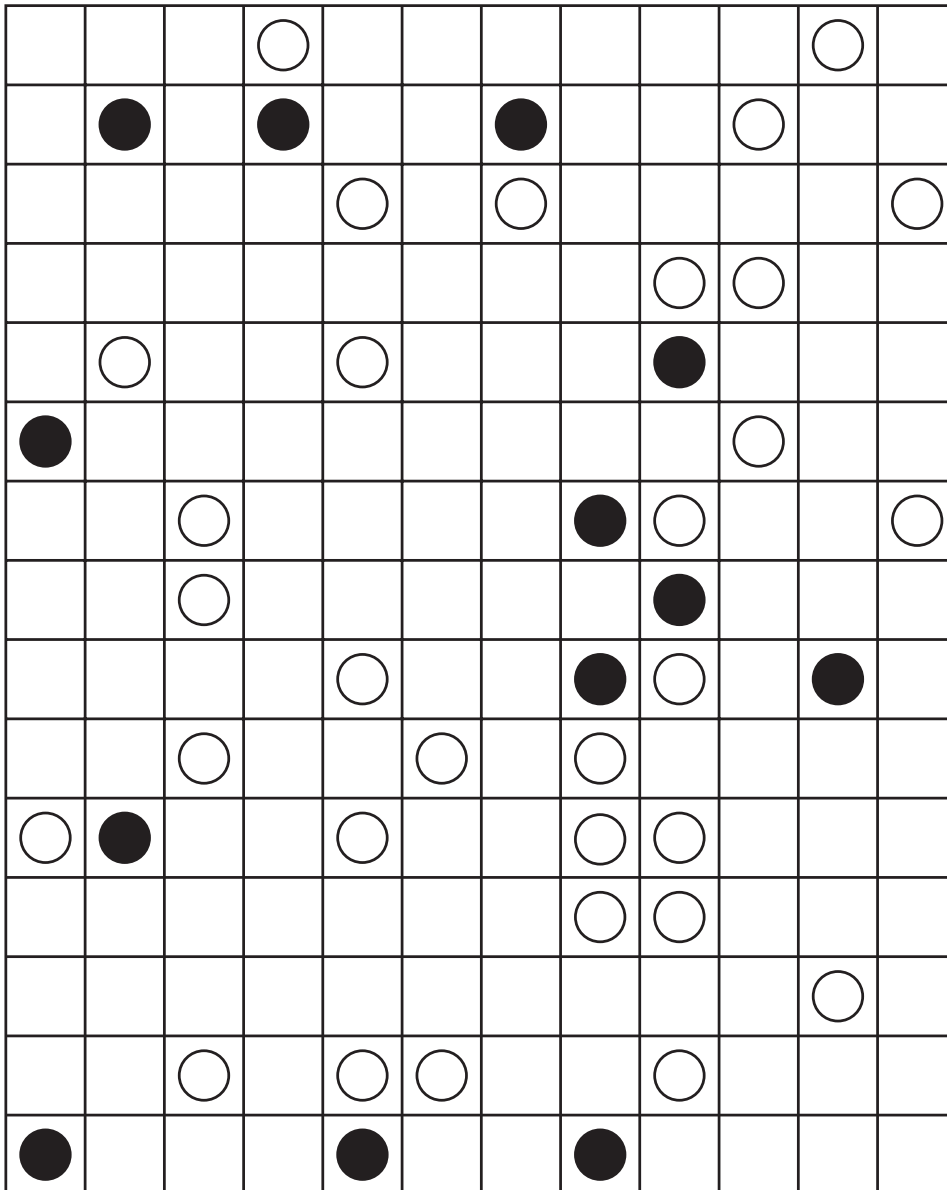## A SCHEDULED BROADCAST FROM THE PEOPLE'S SUPREME puzzleMASTER

Welcome back, **puzzleSOLVERS**!

Last issue's puzzle was a tricky one, I hope you enjoyed it! Here's a recap of the rules: The goal of a Masyu puzzle is to draw a single, unbroken loop from box to box, which never crosses over itself. Squares with black circles indicate corners, and the loop must make a turn in the square, AND in each of the squares where the loop extends from the corner, it may not make a turn. Squares with white circles indicate straights, and the loop may not make a turn in the square with the white circle. Furthermore, the loop must turn in one, or both, of the squares where the loop extends from the straight.
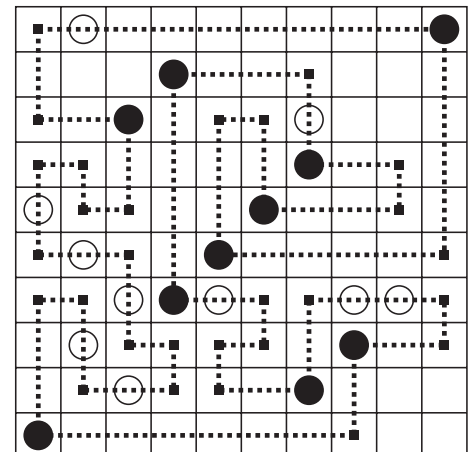
The puzzle this issue won't get any easier! What you might have noticed in last issue is that it got easy when you worked the loop into the middle. Because the line extends two squares out from each black circle and turns, and because the loop can't cross over itself, black circles against a wall or against a flat part of the line give lots of information!

Here's another hint: because the line must turn in one of the squares extending from a white circle, you can't pass directly through more than two white circles at once.

goodLUCK!
the **puzzleMASTER**

LAST WEEK'S SOLUTIONS

C	A	R	D		T	O	O	K		A	T	I	L	T
U	B	E	R		R	A	N	I		R	O	D	E	O
P	L	E	A	S	U	R	E	D		C	R	E	E	L
W	E	D	G	I	E			D	A	S	T	A	R	D
		O	R	R		P	O	L	I	O				
B	R	A	N	D	I	S	H		U	N	I	T	E	S
E	A	R		A	B	L	O	O	M		S	A	L	T
T	I	G	E	R		E	E	N		E	E	R	I	E
A	T	O	M		A	W	N	I	N	G		O	D	E
S	A	T	U	R	N		I	T	E	R	A	T	E	D
			L	A	T	E	X		P	E	R			
A	P	P	A	R	E	L			T	S	E	T	S	E
C	O	A	T	I		I	N	J	U	S	T	I	C	E
E	L	I	O	T		T	O	O	N		E	T	A	L
S	O	R	R	Y		E	D	G	E		S	I	N	S

SUN JUNE 3	MON JUNE 4	TUE JUNE 5	WED JUNE 6	THU JUNE 7	FRI JUNE 8	SAT JUNE 9
	Last day to start spring 2018 work term and meet minimum 12 weeks			Ontario general election		

SUN JUNE 10	MON JUNE 11	TUE JUNE 12	WED JUNE 13	THU JUNE 14	FRI JUNE 15	SAT JUNE 16
	math**NEWS** 137.3 production night	Spring 2018 convocation begins		Last day to change online exam locations	math**NEWS** 137.3 published	Spring 2018 convocation ends

N REASONS WHY YOU SHOULD VOTE

IN GENERAL...NOT JUST FOR THE UPCOMING PROVINCIAL ELECTION...

- Your education, and life in general can be directly impacted by decisions and changes made by organizations and their leadership around you - especially when that organization is the government!
- You can immediately retort people who ask you, "Have you voted yet?" with (probably) less hesitation.
- Every. Vote. Counts. Dammit.
- You are privileged enough to have a voice in the leadership around you… USE IT.
- More voices on major issues = better decision making in general; we need to know what people think in order to benefit the most people possible.
- You're probably procrastinating on homework anyway, so this is something slightly beneficial that can potentially be done in that time.

Narf Dert

THE GREAT prof**QUOTES** DROUGHT OF 2018

With the return of warm weather to Waterloo campus, the intense heat has dried up that which Math students treasure most: math**NEWS** prof**QUOTES**. Yes, the very lifeblood of not just Math students but students of all faculties is disappearing at an alarming rate. None know who or what is to blame: global warming, chemtrails and bees? are all likely likely culprits. Or, perhaps, it is due to that most insidious and diabolical of reasons: an outlier to a trend that does not signify anything at all for the long run. Whatever the true reason may be, we must act quickly lest our dear prof**QUOTES** vanish forevermore, fading to a mere memory of better, merrier days. So in summary:

Y'ALL LIKE PROFQUOTES. SO SEND MORE PROFQUOTES.

The entire math**NEWS** readership