"WHAT CUTE DATES SHOULD ~~itorED AND HER BF&GF~~ NON-SPECIFIC COUPLES GO ON?"

BF STANDS FOR BIG FROG, AND GF STANDS FOR GIANT FROG. AN IMPORTANT DISTINCTION.

[itorED: I couldn't figure out what to write about this issue, so skip the next three paragraphs if you don't want to read about my love life.]

To all my adoring fans: I have decided to start a polyamorous love cult. Applications now accepted.

For real though, I'm having trouble pinning down the definition of a cult. Specifically, figuring out the minimum number of people required in order to call something a cult. If that number is 3, then it means I already have a cult! Assuming I'm included in the count, that is. However, 3 seems like too few people, just based on instinct alone.

The Wikipedia page for "cult" offers simply, "Groups said to be cults range in size from local groups with a few members to international organizations with millions." Though I doubt my cult will ever reach the status of "international organization", I would still like it to be more than a local group. Ideally, there would be members in every city I visit semi-regularly, so that I will always have a like-minded group of people to spend time with whenever I travel. I currently have members in both Toronto and Waterloo, and am looking to expand to Vancouver and San Francisco, for when I finally get that Cali co-op.

Now, to discuss the actual issue.

This time around, we have **mathASKS** from Professor Benoit Charbonneau, who gave very thoughtful answers to all the questions he received, and also wrote an article that is sadly far too advanced for me to truly understand.

We've also got tons of great content from a new writer, "never seen proof before coming here $\in \mathbb{C}$"! Thanks for coming out, it's great having you here!

There's also a special feature of Sequential Math, comics that help you learn math. Do read the article and associated comic on pages 6−9, and check them out on the site mentioned!

Thanks for reading yet another issue of **mathNEWS**!

itorED

AC	Find the segfault night.
CylonSympathizer	Minesweeper Solving Night.
TheUndecided	**mathNEWS** Production Night. *[itorED: the correct answer!]*
Me	Dates are so so yummy, especially the middle eastern ones from Eid, they are juicy and cute. These dates best go on with light seasoning caramels, dark chocolate. Even tho they're delicious you can only have couple of them at a time because they contain a lot of "heat chilli" and it causes constipation.
Waldo@<3.LE-GASP.ca	Nov 25th and 29th ^~ <3
Teemo	Mr. Paninos
itorED	It doesn't matter because anywhere is a cute date with my gf or bf 💕 (actually though, there's an Asian zine fair in Toronto this Sunday that we're all planning on going to!)
ExtrovertED	MathSoc board games night and anime & chill <3
Zethar	I recommend to start the date with a tour of hell—the markets of the Affyre area are particularly lively at this time of the year—then pass over the famous river deltas a κ Persei, then return home for the core event: laser tag.
e	Consider coconuts.

ARTICLE OF THE ISSUE

This issue's Article of the Issue goes to CylonSympathizer for "**mathGAMES**: Z2 MineSweeper". Who knew that having a quality piece could get you the article of the issue.

Sadly, I don't have any prize lined up for the puzzle, so solvers will have to settle for "street cred". However, you are welcome to submit your puzzle into the **blackBOX**. I'll get CylonSympathizer to mention those who submitted attempts in an article.

Also, for those of you looking to win an Article of the Issue award, I really like new columns and features. Also, you should stop trying to win after winning once per issue.

quizED (Zishen Qu)

mathASKS 135.5
FEATURING BENOIT CHARBONNEAU

PETIT NICOLAS: HOW DID YOU GET SO GOOD-LOOKING?

I appreciate the compliment, but do not have any wisdom to share on this topic.

ZETHAR: WHAT ARE SOME FEATURE THAT YOU LIKE ABOUT WATERLOO?

Being a mid-size city, it is a perfect place to raise a family. That's obviously the current season of my life, so I do not expect the readership of **mathNEWS** to identify here. My favourite museum is the Waterloo Region Museum, particularly the Doon Heritage Village.

WALDO@<3.LE-GASP.CA: ARE YOU STILL SUCCESSFULLY ABLE TO MAKE IT TO YOUR OFFICE AT 7:45AM FOR THOSE 8:30AM LECTURES? ANY OTHER ADVICE FOR NOT-MORNING PEOPLE?

Absolutely. On semesters where I do teach at 8:30, I do arrive at the office at 7:45. It is my responsibility to start the class on time, so I want to leave enough of a buffer that if something goes wrong (bus is delayed, my bike has a flat tire, etc), I will still be there on time.

At one point in my life, I realized my relationship with the alarm clock was ridiculous. In fact, I regularly overslept by 45 minutes to 2 hours. That all changed when I realized that, in the morning, I am mentally weak. So here is my advice: in the evening, when you are mentally strong, decide at what time you want to wake up, and set the alarm. In the morning, just manage this decision and do not allow yourself to change the decision. When the alarm rings, you get out of bed. Fear the precedent it would create if you decided at that moment to sleep another 2 or 20 minutes. Just get up.

One important piece in the implementation of this strategy: on days where you are unsure when to wake up, do not set the alarm at all.

RODNEY CHEN: ARE YOU GOING TO BUILD THE 600-CELL?

I already did this past May. As I was preparing for my CUMC talk, I had to decide which one to build in Montréal. I had already built the 120-cell, and I thought I should try the 600-cell. They both look cool, but the 120-cell was nicer. So that is the one I built in Montréal.

I bet many readers of **mathNEWS** have no clue what we are talking about here. So for their benefit, let me give this very quick intro. You probably all remember that there are 5 platonic solids: the tetrahedron (4 triangular faces), the octahedron (8 triangular faces), the icosahedron (20 triangular faces), the cube (6 square faces), and the dodecahedron (12 pentagonal faces). These are the only regular polyhedra in Euclidean 3-space. In Euclidean 4-space, there are only six regular polytopes, and amongst the most beautiful and

complex of those are the 120-cell and 600-cell. The 600-cell is built of 600 tetrahedra as the top dimensional facets (what we call cells, hence the name, as if we called a cube a six-face), 1200 triangular faces, 720 edges and 120 vertices. Its dual, the 120-cell is built of dodecahedra, 120 to be precise.

BUCKYBALL: UPDATES ON YOUR POLYTOPES COURSE?

You'll love it. PMATH 320 Euclidean Geometry is scheduled to be offered for the first time in Spring 2018. It has been on my mind for quite some time now and I keep having ideas on how to present the material. It is not only about polytopes, but all about Euclidean geometry in 2, 3, and higher dimension. It is about polytopes (polygons, polyhedra, and their higher dimensional analogs), symmetries, axioms, ruler and compass, tessellations, sphere packings, etc. It is the geometry course everyone wished they had taken as an undergrad.

PENTAGON: WHAT'S YOUR FAVOURITE POLYHEDRON?

With my personality type, I hate such questions. That is I hate the idea of choosing a max or min in something which is not inherently ordered. What is my favourite fruit? One amongst pear, peach, mango, pineapple, lichee. Do I really need to pick one? Who is my best friend? I don't know, do I need to have one I prefer? Which one of my child is my favourite? Are you crazy? I love them all equally.

If I am forced to choose one above all else, I'll go for the dodecahedron.

IBID: WHAT DO YOU THINK OF HOLONOMY IN G_2-MANIFOLDS?

I think it is a subgroup of G_2. I find it acceptable to be a proper subgroup. I am not a purist who insists it should be G_2.

LE QUEBECOIS: COMMENT EST-CE QUE VOUS PENSEZ D'ENSEIGNER MATH 137 EN FRANÇAIS?

That reminds me of one course I took at UQAM, a French speaking university. Steven Boyer is a fantastic teacher, and many of us thought we should take advantage of the fact he is an anglophone to improve our own English. So one semester we asked him to teach in English. One single student in the class objected, so Steven continued in French. But at one point this student left the country for the rest of the semester, and for the rest of the semester, we learned algebraic topology in English.

GREEK PROFESSOR: WHAT WERE YOU THINKING WHEN YOU CLOSED YOUR EYES DURING MY TALK?

It is unlikely that I remember. I was probably sleeping. Oh, wait, this question is flipped… you must be this student who was sleeping in my differential geometry class. Don't worry, I do not mind. I do understand that despite all efforts, we sometime fall asleep.

CONCERNED STUDENT: DO YOU STILL BIKE TO THE UNIVERSITY? HOW OLD IS YOUR BIKE?

I do. I have been biking all year long ever since I moved to Waterloo in 2010. At the time, I had a 40 -year-old bike I had bought for $100 in 2001. In fall 2014, I decided it was time to upgrade and bought myself this nice mountain bike. October 2015, it was stolen in my backyard. And I waited until March 2016 to buy a new one. This one is not fancy at all, it is a 7 speed commuter bike. Not fun to ride, but did not cost as much. I blame my pneumonia of February 2016 on the fact I was not biking that winter. Your concern is misplaced. You should be concerned if I were to stop biking to the university.

SAD FAN: WHAT ARE YOUR THOUGHTS ON HOW THE CANADIENS ARE PLAYING RIGHT NOW?

You want the truth? You can't handle the truth. The truth is I really don't know, and I really don't care.

SILVERCHASE: LA POUTINE DEVRAIT-ELLE ÊTRE MÉLANGÉE AVEC D'AUTRES METS? (PAR EXEMPLE, POUTINE À LA SHAWARMA, POUTINE THAÏLANDAIS)

I do not particularly like poutine. I also believe great things have come by trying weird combinations. Do whatever you want with the basic ingredients.

TOM MROWKA: DO YOU STILL KEEP IN CONTACT WITH "THE SPECIAL GIRLS THAT SHARED [YOUR] LIFE"? IN PARTICULAR ANNE-MARIE AND CAROLINE?

I am a sentimental person, and always strive to keep connections with people that played an important role in my life, be it those two special girls (two former girlfriends), the actual Tom Mrowka (my PhD supervisor), former housemates, and many others. I do not always succeed, but I try. Being friends on Facebook do not count in my mind.

TEEMO: HOW DO YOU KNOW THAT YOUR MEMORIES ARE TRUE?

Wow! That's a beautiful philosophical question. This is the type of question that could occupy many evenings with friends around a campfire. I sincerely have no clue.

B.: HOW MANY MANDELBROT JOKES DO YOU GET A TERM?

Never got any. Yes, we share the same first name, but that first name is not so rare in Canada. So no one ever thought of mentioning Mandelbrot to me before you did.

THEUNDECIDED: WHAT IS THE CORRECT WAY TO PRONOUNCE POUTINE?

Ça s'écrit comme ça se prononce. It should be pronounced the way it is written, but you need to know how to pronounce French.

ED LEE: DO YOU LIKE GRAPH THEORY?

I do not think about it that much. The part of it that I know is what we teach in MATH 239. It is cool but very basic. About the current stuff I do not know much, but there seems to be very interesting results and problems about infinite random graphs.

PM-ME-GEODESICS: WHAT'S THE WILDEST PROOF YOU'RE EVER SEEN?

Another ordering question.… What if I make a mistake in ordering and I realize some day later this was not the wildest proof? I will not be able to sleep in fear of making a mistake.

What does wild mean for a proof? I'll interpret that as "interesting and using a lot of different ideas". With that definition in mind, one of the wildest proof I've seen recently is the construction of compact G_2-manifolds by gluing families of Eguchi-Hanson spaces by my colleague Spiro Karigiannis and his co-author Dominic Joyce. They produced an 82 pages paper (see https://arxiv.org/abs/1707.09325). The construction uses many different pieces of technology. I love it. Very ingenious.

Another one which totally took me by surprise was a proof I heard last year at a conference called *Stochastic Topology and Thermodynamic Limits*. Antonio Lerario, prof at SISSA in Italy, gave a talk titled "A probabilistic approach to real enumerative geometry." Amongst other things, he proved using probabilistic methods the classical result that there are 27 lines on a generic cubic in complex projective 3 spaces. It was absolutely delightful and inspiring. Moreover, the technique of Lerario and co-authors is used to unlock many more enumerative results that could probably not be found using classical techniques. See it for yourself in https://arxiv.org/abs/1610.01205.

SALTY AND SAD: IF YOU TAUGHT DIFF GEO AGAIN, WHAT WOULD YOU DO DIFFERENTLY?

Good question. I am not sure what I'll do different, but certainly I will do something different. There is a lot of discontent around my iteration of PMATH 365 of last winter. One of the issue was that many students compared this new rendering to my previous one, and blamed me for not delivering at the same high level. This is very unfair, as the decision to lower the level at which the course was pitched was the geometry group decision, not only mine. We are trying to find the appropriate level for all pure math majors, not only the elite. But perception is important, and I think the students' concerns are legitimate. I am still reflecting on it, as I do not know the proper answer yet.

CHENOIT BARBONNEAU: WOULD YOU ENJOY IT IF PEOPLE CALLED YOU "THE CHARBONNATOR"?

I certainly would not. I do not accept people calling me by any nicknames unless they have known me before I started objecting to people using nicknames to call me.

FRANÇAIS BOI: EST-CE QUE JE PEUX ALLER À LA TOILLETE S'IL VOUS PLAÎT?

Oui bien sûr. We live in a free world, so please go to the bathroom if you need. Only during proctored exams must you be accompanied.

QUINCY LAM: IS FRENCH A REAL LANGUAGE?

I'll let the readership decide on the answer, and on the implications of that question.

ADAM JOHN MICHAEL BROWN: YOU RECOMMENDED A MALE DANCE BAR AT CUMC IN MONTREAL, DO YOU HAVE ANY RECOMMENDATIONS OF A SIMILAR NATURE IN WATERLOO?

I never recommended it. As we exited UQAM and passed in front of 281, I mentioned its specialty as I find it singular (most stripper bars are exhibiting women, nor men). It is certainly a feature of UQAM to be surrounded by stripper clubs. Despite the easy access, I have never been to a stripper club. This is not an industry I am willing to support. You vote with your dollars, and I bring my dollars elsewhere. So, no I have no recommendations of a similar nature in Waterloo, or anywhere else for that matter.

You want a recommendation? I do recommend Charles Quality Meats, either at the St.Jacobs or Kitchener market, or at their new store on Weber. The bacon is really good. Really good. Your life will never be the same.

QUIZED: HOW CAN I BECOME FRENCH IN ORDER TO BECOME A GEOMETER?

You can do both separately. Now I should point out that to become French, you will need to acquire French citizenship. I am not French, I am francophone. I am now a franco-ontarian I guess. If you live here in Ontario, there are plenty of opportunities to practice French. Read novels in French, as this will help you internalize the structure, watch shows on tou.tv, listen to La première chaine de Radio-Canada, or Ici Musique, and speak in French as often as possible. Most importantly, do not be afraid of looking foolish. You might think you will look foolish, but in fact you won't.

To become a geometer is an entirely different question. I can guide you, but not in as few words. Drop by my office and we can chat about it.

STRESS SELFIES

I need help. I take selfies when I'm stressed, but now that midterms are over, everyone's mad at me because I keep breaking streaks.

Advice must be in meme format.

never seen proof before coming here $\in \mathbb{C}$

CALL FOR CONSTANTS

The Faculty is undertaking an ambitious exercise to refresh the north-east stairwell of MC and invites your help!

The plan is to add a numberline in the style of a metric ruler all along the stairwell walls from the basement to the top floor. Mathematical constants and symbols will be affixed to the walls to help identify one's location between floors.

We have some constants/symbols, e.g. Liouville's constant, the golden ratio, pi; however we need many more, particularly between 3 and 7.

Gather your friends, collaborate, and email your submission(s) to Debbie Brown (dabrown@uwaterloo.ca) by January 19, 2018.

Debbie Brown

PIZZA DISTRIBUTION WOES

I'm a picky eater. There's only half a dozen things I'll eat on a pizza. This means that when **mathNEWS** decides what pizzas to get, of the seven or eight pizzas they get, only one or two actually have any appeal to me. Now, this wouldn't be much of a problem, but those one or two pizzas are often the more popular ones. They're often gone by the time seconds come around, while the all fancy interesting pizzas with weird stuff[1] on them are still available. *[itorED: Just go on PizzaQuest and you'll get first pick. Problem solved!]* Now obviously starving artists[2] can't be too picky, and if people actually want to eat pizzas with stuff I don't like on them I can't fault them for it. But it would be nice if we had a system in place to make sure they're actually eating those pizzas and not just the ones everyone is ok with eating.

One possible solution is to give everyone a budget of "pizza tokens" of some sort, that they can bid on pizzas that are proposed. If a token is bid for each slice of that pizza, it will be one of the pizzas acquired. If not, everyone bidding on it gets their tokens back. Once the pizzas are actually here, you can only take one slice per pizza per token you bid on it. All that this would require is a much slower and convoluted pizza ordering process and some sort of pizza wardens to enforce things. And hey, isn't a little totalitarianism worth it to make sure people get the pizza they actually want?

Hungrily yours,
$s,t \in \{2k, k \in \mathbb{Z}\}, 144$

1. Translation: pineapple, anchovies, literally any vegetable other than black olives or mushrooms, etc.
2. If you can call **mathNEWS** writers artists.

Differential geometry meets stochastic geometry

Benoit Charbonneau

13 November 2017

In 2-dimensional Euclidean space, one can easily pack equilateral triangles so that they cover the whole space. Each vertex is surrounded by six triangles. In 3-dimensional space, there is room for approximately 22.795 tetrahedra to share a common vertex, and approximately 5.104 tetrahedra can fit around a common edge. Coxeter called this problem the statistical honeycomb. Coxeter was very poetic.

If you decide to curve the space, you can close this gap: it is in fact possible to tile spherical 3-space with regular tetrahedra, with exactly 5 of them around each edge. You can obtain this tiling by putting a lamp at the center of 4d Euclidean space, and observing the shadow of the 600-cell, the regular polyhedra we talked about earlier in the math-ASKS section, on the 3-dimensional sphere.

Let's move up in dimensions. To each dimension k face F of a triangulation of $\mathbb{R}^n$ ($k = 0$ for a vertex, $k = 1$ for an edge, etc), the face F is contained in $q_k(F)$ top-dimensional faces. In the tessellation of $\mathbb{R}^2$ given in the first paragraph, $q_0(v) = 6$ for all vertices v and $q_1(e) = 2$ for all edges e. We can take the average over all possible k-dimensional faces, and denote this number $\bar{q}_{k,n}$.

On the differential geometry side, imagine an ideal but non-possible scenario, a generalization of the statistical honeycomb of Coxeter. Let $\bar{q}_{k,n}^{\text{ideal}}$ count how many possible regular n-dimensional simplices one can wrap around a k-dimensional simplex. I have mentioned in the first paragraph that $\bar{q}_{0,3}^{\text{ideal}} \cong 22.795$ and that $\bar{q}_{1,3}^{\text{ideal}} \cong 5.104$. In fact, $\bar{q}_{0,3}^{\text{ideal}} = \frac{4\pi}{3 \arccos(\frac{1}{3}) - \pi}$, and, for all n, $\bar{q}_{n-2,n}^{\text{ideal}} = \frac{2\pi}{\arccos(\frac{1}{n})}$.

On the stochastic geometry side, imagine producing a locally finite set $A \subset \mathbb{R}^n$ by mean of a stationary Poisson process. Suppose the convex hull of A is all of $\mathbb{R}^n$. For simplicity, also assume that there are no subsets of A of $n+2$ points lying on a sphere. In the case where A is given by a Poisson random process, it occurs with probability 1. We triangulate space in the following manner: a set of $n + 1$ points in A are the vertices of a n-simplex of the triangulation if and only if the interior of the sphere through those $n + 1$ points has no intersection with A. The produced triangulation is called the Delaunay triangulation. The quantities $\bar{q}_{k,n}$ are now random variables, and denote $\bar{q}_{k,n}^{\text{Poisson}}$ their expected value. The book [2] describes the state of the art for computing these quantities. One can compute for instance that $\bar{q}_{1,3}^{\text{Poisson}} = \frac{144\pi^2}{24\pi^2 + 35} \cong 5.228$, and $\bar{q}_{2,3}^{\text{Poisson}} = \frac{286}{59} \cong 4.847$.

For $n \geq 5$, all the techniques known are not enough. In [1], we supplemented these classical techniques with simulations to compute estimates for all the $\bar{q}_{k,n}^{\text{Poisson}}$ for $n \leq 8$. We also computed numerically all the $\bar{q}_{k,n}^{\text{ideal}}$ for $n \leq 8$. Physical considerations suggest that perhaps $\bar{q}_{k,n}^{\text{Poisson}}$ and $\bar{q}_{k,n}^{\text{ideal}}$ are

getting closer as $n \to \infty$? To a pure mathematician, this is highly unsatisfactory and begs for a formal proof. Since the publication of [1], I have found an old and beautiful theorem of Schläfli from about 1850 that helps in computing an asymptotic formula for $\bar{q}_{k,n}^{\text{ideal}}$.

I have no clue how to get an asymptotic formula for the Poisson statistics. In fact, a few years ago I knew nothing of stochastic geometry. Research brings you across the landscape of mathematics, and you should go where the problems are. Very often, the interesting problems are at the common boundaries of two or more disciplines. Our Faculty is divided along departmental lines that need to be crossed at every opportunity. Such lines only exist to simplify the administration of the Faculty. They should not restrict our learning and research.

References

[1] Benoit Charbonneau, Patrick Charbonneau, and Gilles Tarjus. Geometrical frustration and static correlations in hard-sphere glass formers. *Journal of Chemical Physics*, 138(12):12A515, 2013.

[2] Rolf Schneider and Wolfgang Weil. *Stochastic and integral geometry*. Probability and its Applications (New York). Springer-Verlag, Berlin, 2008.
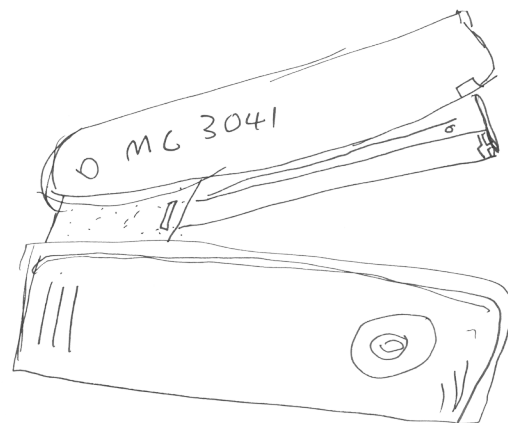
LIVE ROCK AT THE BOMBER TOMORROW!

This Saturday November 18 two rock bands will be performing at The Bombshelter. Both feature UW staff members. Robyn Landers from MFCF is in Boston tribute band Hitch A Ride, while Lawrence Folland and Dan Hergott from CSCF play classic rock in Radio Memories. Come on out and enjoy some great rock music and see what those campus IT guys do in their spare time. As an extra bonus, CS prof Dave Tomkins assumes his alter-ego of DJ Dancin' Dave. You have to see it to believe it!

Even better, it's a fundraiser event for UW's United Way campaign, so there's no set cover charge. Just pay what you can at the door, and proceeds go to the United Way.

Doors open 6:30, Radio Memories starts at 7:30, Hitch A Ride around 9:30 pm. See https://uwaterloo.ca/united-way/events for more details, and be sure to rock out at the Bomber on Saturday!

BOOKS AND GAMES

This is a reminder that the Feds Clubs Library in SLC exists, and is filled with many entertaining books and things. Comic books, novels, rulebooks for RPGs and tabletop games, and even entire games of paper chits from the 80s are sitting on shelves waiting to be enjoyed! Whatever genre you are into, you are likely to find something to your liking at the clubs library. Want some stompy mechs? Battletech in various flavours. Classics? D&D in a few editions. Asimov, Tolkien, Superman, you name it. [INSERT GENRE YOU PREFER]? [GENERAL POSITIVE STATEMENT].

So come on down to the Clubs Community Center, SLC 2139, Monday to Friday 10am−3pm. Lonely print media is waiting for you!

Soviet Canadian

POEMS FOR THE SOUL

MIDTERM SEASON:

There once was a little equation
that had 100 Evasion.
I'd forgotten to shower,
and forgotten the theorem,
and now they've deported me from this nation.

π

pi is a mystery of the ages
to write it will take many a pages
if you simply put three point one four
simply find your way out the door.
even engineers have twenty two slash seven
and physicists have square root of g
to some it's a three
or just round down to zero
but the best estimation is e

I SLEPT IN MC COMFY

I fell asleep in MC comfy,
and I am not ashamed.
though it smelled like body odour
and feet

"ETHICS"

I'm stuck in an ethics lecture
and don't know how I got here
just went on a little adventure
now stuck in my seat in fear

WHAT NOW?

midterms are over
now my soul
so free
so empty
yet
I could never
function the same way feel the same high as when
the adrenaline and stress pumped through my
shaking hands my dreams filled with proofs my
sleep divisible split by revolution and solutions and
so empty

NOT A POEM

this is not a poem
wubba lubba dub dub
wubba lubba dub dub
wubba lubba dub dub dub

never seen proof before coming here $\in \mathbb{C}$

6 TYPES OF mathNEWS CONTENT

1. COVERAGE AND INTRO

- printed on coloured paper, diversity is our strength
- often a drawing related to goose and puns
- contains the title (volume information)
- it has "article of the issue" detailing the issues we face everyday
- intro has a Q&A section for the editor and contributors to shitposting

2. mathASKS

- relatively new section of **mathNEWS**
- what happened to **horrorSCOPES**?
- reason for editors to harass the school staff
- people have yet to ask for assignment solutions
- answers consist of "I remember that", "I don't", "maybe", "yes", and "mmh"

3. profQUOTES

- oldest section of **mathNEWS**
- list of quotes from profs who teach 14x, 24x, CS452, "enriched", and PMath courses
- reeks of references you won't understand if your IQ is below 99.9999999986916 precentile
- **profQUOTES** are often made up, or not but I can't tell

4. ACTUAL CONTENT

- articles from contributors
- quality expected from someone who just came for pizza
- consist of math references, lists, personal stories, and current events
- most are lame, but once in a blue moon there will be the spiciest content (which editors usually remove before publishing) *[itorED: if someone writes spicy content for mathNEWS but the editors remove it before it's published, how can you be sure the spicy content existed at all?]*

5. gridWORD AND OTHER "PUZZLES"

- what kind of newsletter is it if it doesn't have a crossword section.
- the complexity of the problem is supposed to be NP-Hard but I suspect it's actually Titration complexity.
- this is the reason why UW invests in deep machine learning and quantum computing.
- turns out that most the problems are all Undecidable, just like my CS assignment ;-;

6. LAST PAGE (lookAHEAD)

- consists of calendar for events related to math
- meme stolen from Facebook
- drawing by people not from arts
- still better art than whatever come out of Arts faculty because they are actually AFM students who aspire to draw money instead

Help me come up with author names pls and thanks

WHAT IF COMICS COULD HELP YOU LEARN MATH?

This is the idea behind Sequential Math, a new comic series covering key concepts and theories in advanced, university-level mathematics. Written by Giuseppe Sellaroli and Amanda Garcia, a MATH 237 lecturer/quotable prof and Engineering PhD candidate/relapsed mathematician, respectively, Sequential Math uses comics to explain rigorous math with equally rigorous drawings.

The comics originally started as learning aids for Giuseppe's MATH 237 course this Fall term. Due to its early success and to the unbridled naive optimism of its creators (mostly the latter), the series has graduated to an ongoing project which will continue beyond MATH 237 and expand its scope of topics to other areas of math.

Each self-contained comic delves into a specific topic and presents its core ideas in a thorough yet easy-to-digest manner. The comics are designed to complement and to supplement more "traditional" learning materials such as textbooks and to keep math fun. So far, three comics have been published, covering multi-variable limits, differentiability of multi-variable functions, and necessary/sufficient conditions.

The Sequential Math team wants to hear from you: what topics would you like to see explained in comic forms? Drop your ideas into the website's suggestion box!

To learn more about Sequential Math and to keep up with the latest news, visit the official website at https://sequentialmath.com or follow Sequential Math on Twitter (@sequentialmath) or on Facebook.

And now, without further ado, you, dearest **mathNEWS** readers, get to read a limited edition print version of one of these comics! Enjoy!

Cathy!

Cathy!

Cathy, I figured it out!

What did you figure out?

Why Differentiability is defined like this!

Written by Amanda Garcia and Giuseppe Sellaroli
Illustrated by Giuseppe Sellaroli

$$\exists\, \vec{A} \in \mathbb{R}^n \quad \text{s.t.} \quad \lim_{\vec{x} \to \vec{a}} \frac{|f(\vec{x}) - f(\vec{a}) - \vec{A}\cdot(\vec{x} - \vec{a})|}{\|\vec{x} - \vec{a}\|} = 0$$
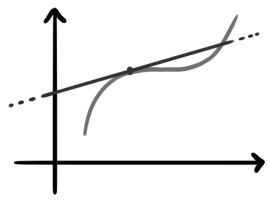
Really?!

Tell me, tell me!

It all comes down to *linear approximations.*

You mean like Taylor series or tangent planes?

Yep! Let us **define** a linear approximation of $f(\vec{x})$ at $\vec{a} \in \mathbb{R}^n$ as a map of this form:

$$L_{\vec{a}}(\vec{x}) = f(\vec{a}) + \vec{A}\cdot(\vec{x} - \vec{a}), \ \vec{A} \in \mathbb{R}^n \quad \text{s.t.} \quad \lim_{\vec{x} \to \vec{a}} \frac{|f(\vec{x}) - L_{\vec{a}}(\vec{x})|}{\|\vec{x} - \vec{a}\|} = 0$$
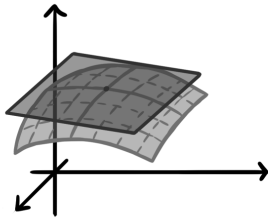
generic polynomial of degree 1 in x satisfying $L_{\vec{a}}(\vec{a}) = f(\vec{a})$

This means it's a good approximation

In one variable, the graph of a linear approximation is a *line*.

In two variables it's a *plane*.

In three variables it's a *hyperplane*.

What does a hyperplane look like?

I'm not sure. I couldn't find any pictures

Ok, I understand the definition, but why is the approximation good if *that* limit goes to zero?
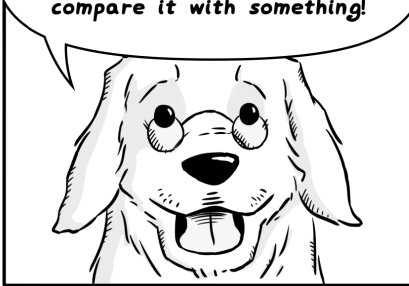
It seems a bit arbitrary to me.

Let's break it down.

We use this ratio because the error in the approximation is a meaningless quantity unless we *compare it with something*!

Measures the error in the approximation

Measures the *relative error*

$$\frac{|f(\vec{x}) - L_{\vec{a}}(\vec{x})|}{\|\vec{x} - \vec{a}\|}$$

Measures the distance of $\vec{x}$ from $\vec{a}$

What we are actually asking is that the relative error can be made as small as we want if we are close enough to the point $\vec{a}$.

I think I'm starting to get it.

From a different point of view, we ensure that terms left out of the approximation go to zero *faster than linearly*.

That reminds me of the remainder of Taylor series.
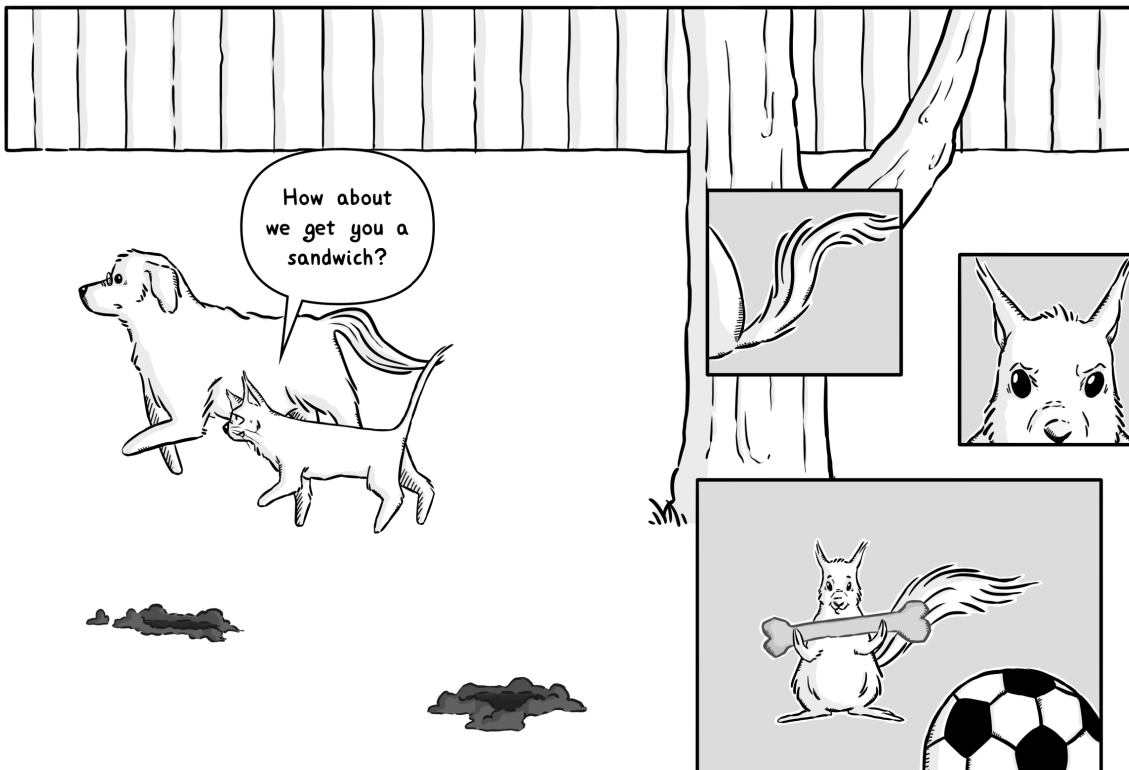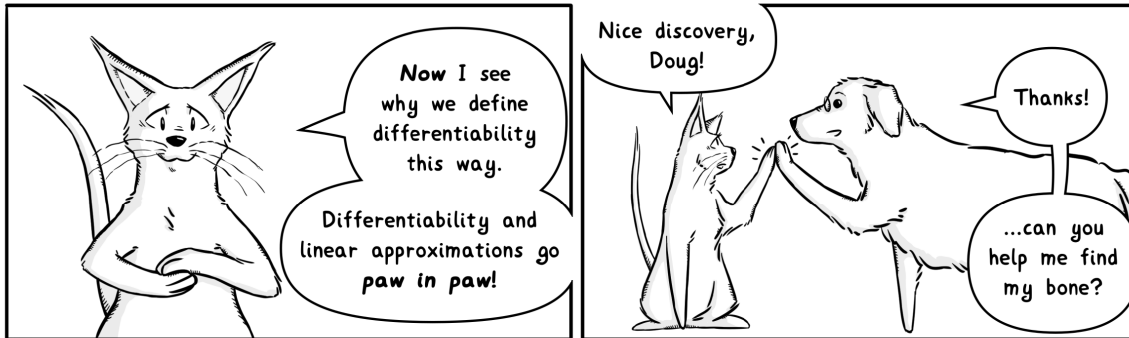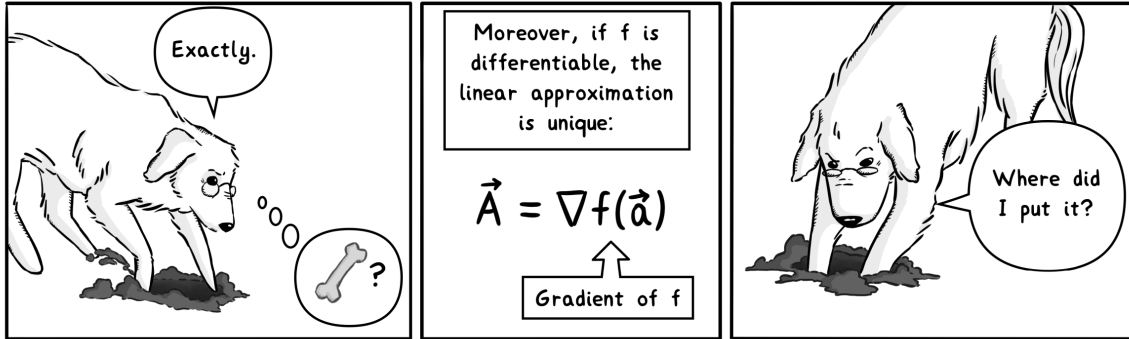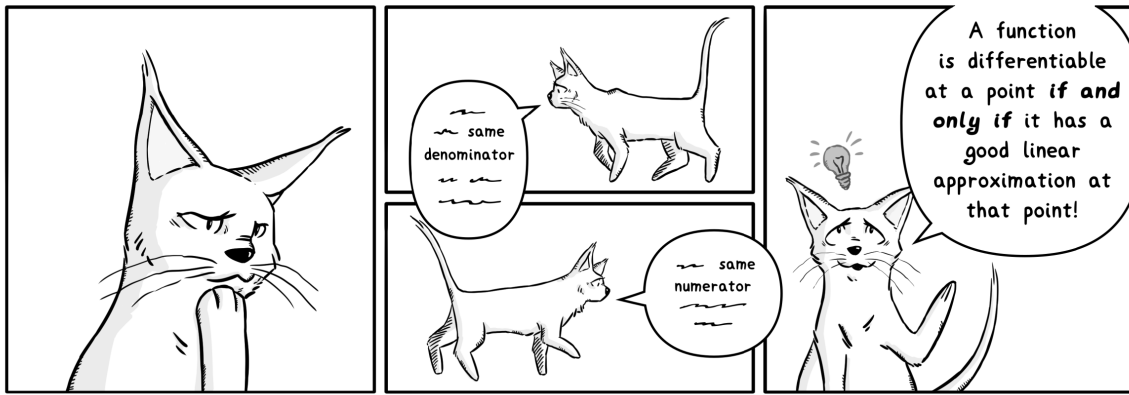
It's exactly the same idea!

Ok, I'm convinced. The approximation is good if the limit of the relative error is zero.

But what does this have to do with differentiability?

Take a look at the definition again. A function $f(\vec{x})$ is differentiable at $\vec{a} \in \mathbb{R}^n$ if and only if:

$$\exists \vec{A} \in \mathbb{R}^n \text{ s.t. } \lim_{\vec{x} \to \vec{a}} \frac{|f(\vec{x}) - f(\vec{a}) - A \cdot (\vec{x} - \vec{a})|}{\|\vec{x} - \vec{a}\|} = 0$$

Notice anything?

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prof**QUOTES**

CO 342: MARTIN PEI

66 It might be longer than I anticipated. So write fast and we'll see what happens.

66 Proof by imagination.

66 We care about everybody. [class laughs] Or maybe not?

66 It's so cold outside, but graph theory will warm you up.

66 If you start playing baseball on a plane, you can do both.

CO 351: MARTIN PEI

66 Oh, this is going to be terrible. Just like everything I do.

66 Anyway, that's my story. Don't go to the plaza.

66 This dual looks slightly ugly so we're going to ignore it for now. Don't do that in real life.

66 Any questions right now, before I turn off the lights and things get more romantic?

66 NO! NO! NO! Yesss.

66 I should say that this is not a sponsored lecture. So Ford has no [involvement].

66 In the worst case, it's really bad.

66 I can still English.

66 I've been sad and disappointed all my life.

66 When you receive the midterm back, don't email me. I want to have a happy weekend.

66 You can use two, but I feel like infinite today.

66 We're going to talk about min cuts. Hopefully. Once I learn it.

66 You have a whole weekend to think about it. Or not.

66 [Student: Is it going to be hard?] I don't know, I haven't even learned the material yet.

66 I can't, because everything is flat, just like the Earth.

66 Today's Monday, right? Aww, I thought it was Friday already.

STAT 341: RYAN BROWNE

66 Sometimes the TAs do strange things.

CS 489: YAO-LIANG YU

66 Exercise 2 and exercise 3 are very simple. I almost feel very bad to give you such simple exercises.

CO 456: GABRIEL GAUTHIER-SHALOM

66 I don't have a requirement to make it possible to get 100% in this class.

66 I was that kid. I know all the tricks. I can recognize them.

66 Why did I get two quotes about me being mean? I got two different quotes. It might have been from both of my classes.

66 I would be mean and say, 'Hasn't anybody reviewed their CO 250 notes?'

66 I'm doing this awkward thing where I keep talking and it keeps getting worse and worse. I know this makes sense. Just not to me right now.

66 I was trying to pretend I'm nihilistic and angsty, but it didn't work.

PMATH 930: ROSS WILLARD

66 [Written on the board] !!Woohoo!!

66 I don't really know what you should be doing. Maybe just checking Facebook.

66 Oh my God! I'm brilliant! I set this up that way, didn't I?

66 [said on Monday]…if any of you remember. I know it's a loooong time ago, last Friday

66 It was published in '67, so still a long time ago ... from your perspective.

66 If you're wringing me out for repeating myself and wasting your time, I'm sorry. [Cries into notes] I'm so sorry!

66 This theorem is celebrated to this day. Hmm, interesting pun! It is due to Alan Day, who was a Master's student at McMasters.

PMATH 331: ROBERT ANDRE

66 No googling during the exam.

66 You might say Squeeze Theorem is just for kids.

MNS 101: JAN KYCIA

66 What is this good for? It's good for theorists. It keeps them employed. It keeps them off the streets. It keeps the streets safe.

MATH 237: MUKTO AKASH

66 I'm going to write bounded as 'bded'. I think the word bounded is too long.

66 I don't know if I'm spelling parameterized correctly. I don't care right now.

66 We have one minute left. Okay let's try this.

KOREA 101: YOUNG GON KIM

66 Life is stress.

HOW TO PROPERLY PREPARE FOR FINALS WHILE YOU STILL HAVE TIME

Now that midterms are over, we have about three weeks before finals season starts rolling around. This is the perfect opportunity to actually pay attention in class instead of skipping.

One great thing about finals season, is that there are no classes or assignments, so you can spend that time studying extremely diligently so that you will be prepared for that exam that is worth- oh my god, I didn't look at the syllabus before this.

1. Actually do your assignments.
   One of my friends did a lot of work with other people or just copied, and is now struggling a whole lot. A lot of key concepts are missed. Honestly, assignments are worth so little that it's better to treat it as practice to gain understanding, rather than squeeze that 5% that you would've gotten if you understood the material in the first place.

2. Go to multiple lectures.
   Something I've started doing (especially since I have 8:30 classes, and I can't think when I've just woken up) is to go to both the morning and afternoon sections of my classes. I've found that the first time round, scrambling to take notes and cramming all that information in my head means I don't actually understand anything. The second time round, I can actually sit and listen to the prof speak, and think about the material. If you're worried about stealing someone's seat, people usually skip class so much that 80% of the room is empty anyways.

3. Get ahead.
   This might seem like "oh, it's so easy, just do your work." It's a bit more than that. When you

finally finish an assignment, instead of "taking a break" for three days, instead get started on the next assignment. You don't have to finish it, but for many people like me that are only motivated by deadlines, it can help avoid all-nighters, get you some of that sleep, which will in turn help you pay more attention the next day. Sometimes you may find that you finish 50% of the assignment in one go, because you've already "warmed up" so to speak. Reading the rest of the questions also helps you prepare for what you need to pay attention to in class.

4. Review material before class.
   I was getting 20% on my clickers before, but after I started spending ten minutes before class looking through the slides, I started getting all of them correct. It's similar to the "Go to multiple lectures".

I'm not quite eloquent enough, so I'll just steal someone else's words instead (does this count as **profQUOTES**?)

- Exams can obviously be stressful, but in December, you don't have any classes to hand in or assignments to submit!
- Success (in life) is closely tied to persistence.
- Sleep, exercise and relaxation are especially important at a time like this.
- If you are feeling overwhelmed please make use of the resources provided by the university.
- It is easy, but unwise to use cold weather as an excuse for hiding indoors. A cool brisk walk with snow underfoot can be very refreshing. That's what I'm telling myself!
  -Professor Shane Bauman

"We can learn far more from our failures than our successes. So if you cannot solve a problem, leave it for a while. Revisit it later. It might take many attempts to find a solution and sometimes you may never find a solution on your own"

-Professor Shane Bauman

"You may need to cut back on some things in your schedule. Don't let sleep be one of the things you cut back on. Human beings need their sleep. Staying up until the wee hours of the morning to study for an exam or to do an assignment isn't a good plan. First of all, when you are really tired, you probably aren't thinking very well and your nighttime studying/working is not nearly as effective. And second, you will probably sleep in the next day and miss class or go through the day in a daze. That actually puts you further behind and can lead to a vicious cycle where you are always trying to catch up. Ask yourself if that is really worth it. Sleep."

-Professor Shane Bauman

Now that I've given you great advice to ignore, I hope you feel motivated and encouraged.

never seen proof before coming here $\in \mathbb{C}$

FAVOURITE SORTING ALGORITHMS

You may have heard of bubble sort, merge sort, or even radix sort. But those are not your only options, in fact, here's a list of my favourite few:

BOGOSORT

Imagine you wanted to sort a deck of cards. So first you check if the deck is already sorted. If it is, then congratulations! You're done. Otherwise, it's best to just throw the entire deck into the air, and then pick up the cards from the ground. Then check if the deck is sorted. Repeat until it's sorted.

```
func bogosort(list):

    while(list is not sorted):
    shuffle(list)
    return list
```

Runtime : $O(n*n!)$. The sun will burn out before you finish sorting your deck.

SLEEP SORT

The natural way to improve runtime of sorting algorithms is to use concurrency. So let's use threads. We create a thread for each element of the array, and make it sleep for an amount of seconds equal to the size of the array. Then, once it wakes up we add it to a new array.

```
func addElement(item, newList):
    sleep(int(item))
    newList.append(item)

func sleepsort(list):
    newList = []
    for item in list:
    thread.fork(addElement(item, newList))
    // wait for threads to finish
    return newList
```

Runtime: $O(max(list))$. At least the runtime is independent from the size of the list.

STACK SORT

Why reinvent the wheel by implementing our own sorting algorithm. Just go on StackOverflow like every other problem. This algorithm searches StackOverflow for code snippets of "sort a list" and runs them until the list is sorted.

```
func stacksort(list):
    while (list is not sorted):
    code = search(https://stackoverflow.com, "sort a list")
    execute(code, list)
    return list
```

Runtime: ¯_([face not currently supported by mathNEWS])_/¯

QUANTUM BOGOSORT

According to the Many-Universe Interpretation of quantum mechanics, there are many universes in parallel to our own, all slightly different. Thus, we can use this fact to remove all randomness from our previous version of bogosort. We shuffle the list. If it is not sorted, then destroy this universe. If the universe survived, it will have a sorted version of the list.

```
func quantumBogosort(list):
    shuffle(list)
    if (list is not sorted)
    //destroy the universe
    return list
```

Runtime: $O(n)$. I think that's our best yet.

FOOTNOTES:

stack sort is from https://xkcd.com/1185/. It even has an online implementation.
sleep sort was popularized through the 4chan board /prog/
There is no current implementation of quantum bogosort.

someone come up with an author name for me pls

WAIFU SIMULATORS AND YOU

I have a waifu simulator on my phone. This is OK to say because it's ironic or something. What I'm trying to say is that I play Fire Emblem Heroes on the daily and it's pretty alright. I use the small amount of in-game currency they give me (F2P btw) and try to roll for my favourite guys and girls like Marth, Girl Marth, Red Hair Marth, Dad Marth, Red Hair Dad Marth, etc.

They say too much waifu will ruin your laifu, but it always feels like I get far too little. With a base 3% pull rate for the three or four "focus heroes" of the week, I skip a few stages of grief and go directly from anger to acceptance with two simple theorems.

P(you get what you want | you didn't spend thousands of dollars) = 0

P(everything is going to be okay) = 1

If STAT 230 taught me anything, it's that misrepresenting probabilities helps me sleep at night.

AC

TAKING MR. PANINO'S BEIJING CHALLENGE

Like any good student, I approach new things with an academic mindset. When I arrived in Waterloo last fall, I made sure to do my pre-readings on the nearby plaza. I stocked up on coupons, read the health inspections, ignored the health inspections, and dove stomach first into Mr. Panino's Beijing Challenge. This means I'll have to eat all 40 items on their blackboard menu before I graduate.

I've had four items so far—the kung bao chicken, curry chicken, dumplings, and the legendary mapo tofu—and with 2.5/8 academic terms already behind me, my average rate of consumption isn't looking too good. The desire for BK $2 for 10 chicken nuggets and the need for an actually balanced diet have clouded my judgment. My wallet is weak. My stomach is weak. I am weak. But I assure you my resolve has never been stronger.

If you choose to take Mr. Panino's Beijing Challenge, I wish you good fortune in the meals to come.

AC

SLEEPING IN CLASS

My professor saw me sleep in class.
In the front row.

I snore.

[TurnipHED: I spent too long counting syllables to see if this was a haiku. You win this time, writer.]

never seen proof before coming here $\in \mathbb{C}$

math**GAMES** : ℤ2 MINESWEEPER

Hello **mathNEWS** readers, I present to you the newest **mathNEWS** segment, **mathGAMES**. Each edition from now on* will feature an original game, that will involve a variant amount of Math.

If you have any suggestions or critique for the **mathGAMES** segment, you are welcome to send them to **mathNEWS** via the **blackBOX**. *[itorED: This is mounted on the wall outside the Math CnD, above the publication distribution racks.]*

CylonSympathizer

*When I'm able to make it on time.

For this issue, I [CylonSympathizer] present to you : Z2 Minesweeper !

In Z2 Minesweeper, you are given an incomplete Minesweeper Grid, and you are tasked with finding out where the mines are. You solve the game by guessing which unchecked cells contain mines, and which ones don't.

Like Minesweeper, the numbered cells give you information about the total number of mines surrounding the cell. However, unlike classical Minesweeper, the cell doesn't give you the exact number of total mines,surrounding it, but the total Modulo 2.
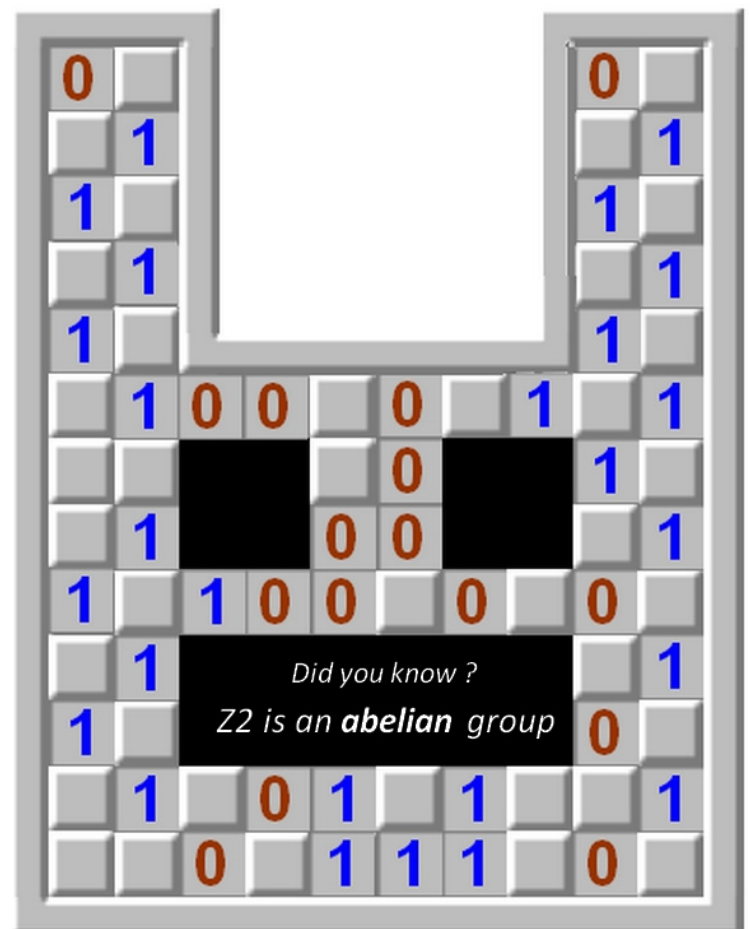
This means that a cell numbered 0 has an even number of mines around it, and a cell numbered 1 has an odd number of mines around it.

You are also provided with the total number of mines in the grid.

Good luck Sweeping !

In Honor of VP Minesweeper of the PMC.

The Grid :

Total Number of Mines is 22.

A FEW WORTHWHILE THINGS TO ENJOY AS A UWATERLOO STUDENT

It doesn't last forever…especially when you take some time off.

- Student Discounts (groceries, household items, restaurant escapades…in this city, there are a lot of discounts to use!)
- Easy Transit Access (make good use of that WatCard people…)
- The Feds Health Plan (your prescription medication might be 6 times cheaper than you would find otherwise)
- The company of the people around you (they might graduate before you can blink)

waldo@<3.LE-GASP.ca

JOKES THAT HAVE 100% CHANCE OF HELPING YOU MAKE FRIENDS

What do you get when you put 10 mathematicians in a room?
A room with 10 mathematicians.

What do you get when you put 1 mathematician in a room?
A lonely mathematician.

How many mathematician does it take to screw a lightbulb?
One, to call the engineer.

Do you know how much pie they gave you on pi day?
$\pi/3$ pies.

How many credits do I need to graduate?
Contact your academic advisor.

Help, I don't understand this question, I tried getting the answer but I don't have the answer, can you give me the answer?
"Have you tried managing your time better?"

Why won't you be my friend?
These jokes suck.

What do you get when you put 2 mathematicians in a room?
A lonely mathematician.

never seen proof before coming here $\in \mathbb{C}$

FACEBOOK'S GRAPH API IS TERRIBLE

So, lately at work I've been tasked with integrating Facebook's Graph API into our application. While this may sound interesting, there are some, how you say, imperfections in the API that make it less than enjoyable to work with. For example, Facebook doesn't seem to really get the whole concept of arrays. For some endpoints, while you'd think they'd return an array of values, they will instead return a hashmap with stringified integers as keys. Naturally, they don't mention this bit in the docs.

The error messages you get back are less than helpful, mostly because half the time it doesn't even bother giving you one. You'll just get back an empty set of braces and then you have to track down the one stack overflow post that tells you that you're missing permissions. It doesn't help that even if you do get an error response back, Facebook does not provide a full error listing anywhere. Some members of the developer community finally got tired and made their own list...in 2012. Needless to say it's not anywhere close to being up to date, but it's somehow still better than Facebook's own documentation.

Speaking of, my god the documentation. It will just straight up lie to you. Imagine this, you spend a week trying to implement something, and finally break down and make a post on the support community. This results in you spending an hour arguing with a Facebook developer over how to get the one piece of data the whole project is based on, only for both of you to realize it is impossible to get that piece of data, even though the documentation explicitly states that you can.

On the brighter side though, there are some issues that are more of a problem for Facebook than for us developers. At one point I needed to test my handling of error responses from the API, so I requested my friends list with a limit of -1 results. Facebook spent 30 seconds trying to process this before spitting back "an unknown error occurred." This may sound like sloppy coding, because it is. Dummy proofing your inputs isn't exactly rocket science. Where it gets better though, is the fact that Facebook allows you to batch up to 50 API requests together. So, if you were to batch a bunch of requests for negative amounts of data together, you just might end up with a way to eat up 25 minutes of server time with a single HTTP request. If I were less scrupulous I might be inclined to use this knowledge, maybe to deny some service or something like that.

You don't deserve to know

# OCTOPODES' HANDY PREREQ CHART: ACTSC EDITION

I wasn't originally planning on doing an ACTSC chart, but someone emailed **mathNEWS** to request it, so I decided "hey, why not?". Here it is.

ACTSC has a somewhat simpler layout than most of the other departments, although this may not be obvious at first, since the chart still looks pretty complicated. Really, though, there are only a few different underlying areas - Property & Casualty, Life & Pension, Corporate Finance, and Loss Models - with the courses in each being very closely clustered. Despite this, the chart is still a little cluttered, because many of these courses have prereqs in STAT and because many later-year courses have 2nd-year courses as prereqs, which leads to lines going all the way from the top of the chart to the bottom.

Unlike some other departments, there is no single course that directly unlocks a wide range of courses (like CO 250 for CO and MATH 235 for AMATH), but it would certainly be prudent to take STAT courses as early as possible. Each of STAT 230, 231, 330, and 333 are required for a fair number of courses, and STAT 230 in particular is indirectly required for almost every upper-year course.

Octopodes
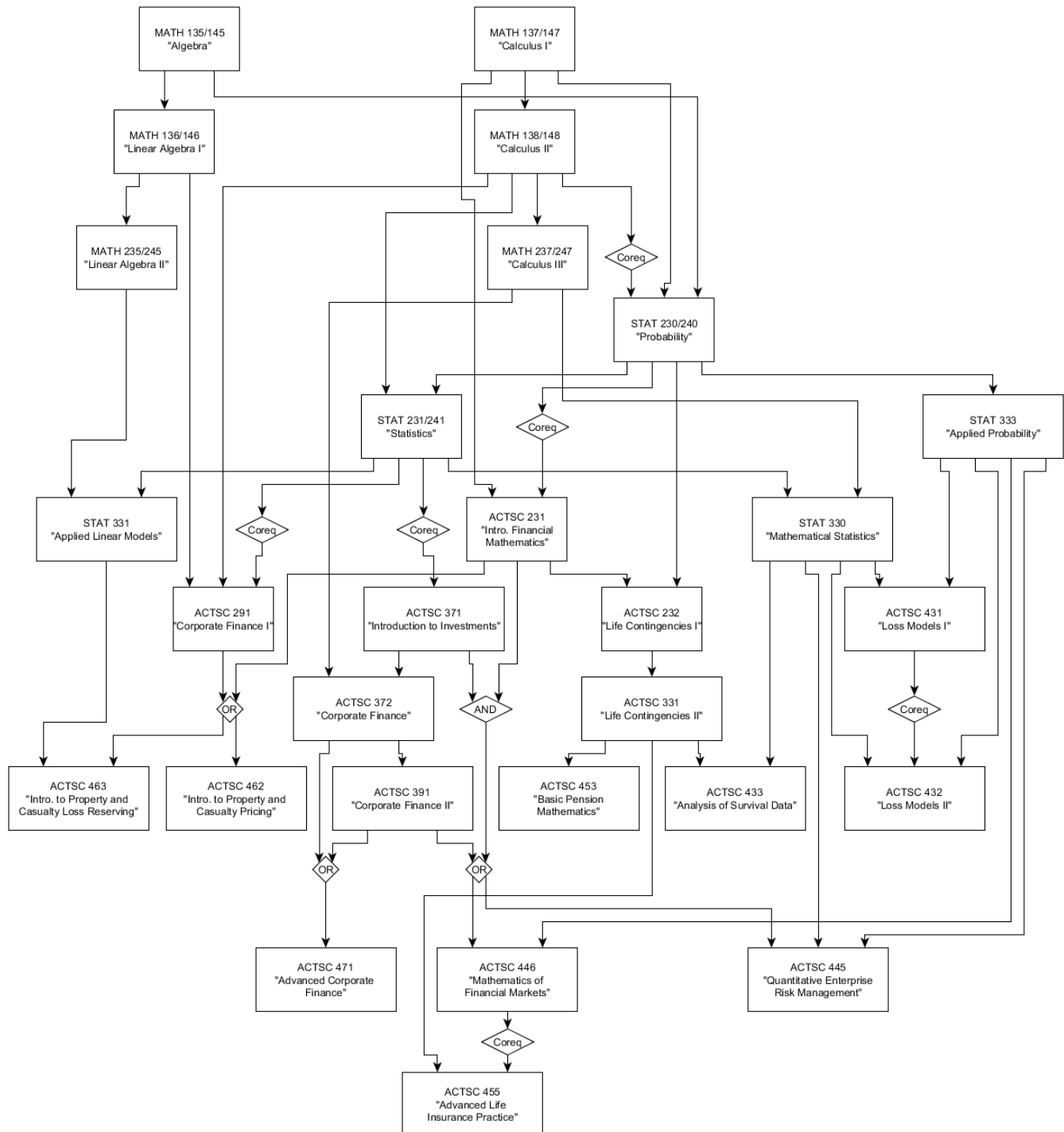
gridWORD

ACROSS

1. Mild exclamation
5. Outsource-resistant
9. Noble
14. 2D measure
15. Second
16. Most obese nation
17. Property peddler
20. Strait of Dover port
21. Pomace brandy
22. Visit
23. Discontinue
25. Animal king
27. Beaver youth
30. Alignment
32. Passes
36. Gulf port
38. Melodramatic outburst
40. Anne kept one
41. Fast raptor
44. Machete
45. Lie detector?
46. Close
47. Proof starter?
49. Stump
51. Ð
52. Sigil
54. Impulse transmitter
56. Rocks
59. Mario
61. Season
65. Safe feature
68. Bramble
69. Norse goddess of fate
70. Turkish dough
71. Dealt
72. Springs
73. Wanton

DOWN

1. Drug agent
2. CO(NH2)2
3. Blue-green
4. Mélange
5. In 2018, begins March 30th
6. Cool slang
7. Mythbuster
8. Music genre
9. Massive snake
10. Label
11. Examples include 3D and 63D
12. Feeds on 34D
13. Sterotypical Bard implement
18. Emerald Isle
19. Foe of the Iroquois
24. Live in squalor
26. Symbols of hardness
27. Yōkai
28. Notions
29. Graceful fliers
31. Street sections
33. Data holding zone
34. Rainbow fish?
35. Hi-tech keyboard
37. A drink of port with citrus, spices, and sugar
39. "D" over the radio
42. Snipe, for one
43. Ghosts of Departed quantities
48. Net
50. Beethoven's birthplace
53. There's interest in them
55. Cancels
56. SALT subject
57. Essence
58. Discharge
60. Red sign
62. Stir
63. Cream
64. Card game for three
66. Comb maker
67. Roman wrath

gridCOMMENT

After the first snow of the term, it is about time that the geese have left the city; no longer do we have to worry about stepping into prime-grade fertilizer when jaunting from class to class. Not that it matters anyway—indoor routes are preferred when Boreas displays its wrath upon us. If only the university could be snowbirds and travel south for the winter… alas, 'tis but a flight of fancy.

Apparently the grid was harder than the previous one, as there were only three submissions, presented here with the answer to the **gridQUESTION** of last issue, which was "What is a word you would like to see in the next **gridWORD**, and what should its clue be?"

- e (and Nicole) submitted a grid with one incorrect letter and answered "Athel. Can't clue a word I don't know the meaning of!" [Author's Note: Don't mind if I do!]
- Patrick Lam submitted a correct* grid and answered "plam: outsource-resistant"
- athamizh and bvenkite submitted a correct grid and answered "Fluxions: Ghosts of Departed quantities"
- I like athamizh and bvenkite's answer best, so please come to the **mathNEWS** office and badger the editors for the prize which has been allocated for your collection.

You may have noticed while walking around on the third floor of MC that there is a BLACK BOX with **mathNEWS**' name on it. If you read last issue's **gridCOMMENT**, you will remember that historically submissions went into the BLACK BOX. I am glad to say that **mathNEWS** now has access to that box for sure, so I get to say the following: submissions to this issue's **gridWORD** can be submitted via email to mathnews@gmail.com, or under the door to the office (MC 3030), which is aliased to the aforementioned BLACK BOX. The submitter who submitted the most correct solution shall be eligible for a prize, and in the event of a tie for most correct, my favourite answer to this issue's **gridQUESTION** shall be the tiebreaker. This issue's **gridQUESTION** is "What is sly, purple, and occasionally smells of brimstone?"

Soar high,
Zethar

*I think; hard to tell since the scan resolution was low.

gridWORD
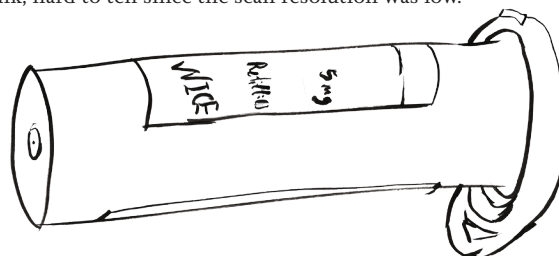
T	S	A	R		P	A	U	S	E		H	A	S	S	L	E
H	E	R	E		A	M	M	A	N		O	M	E	L	E	T
I	N	C	L	I	N	A	B	L	E		G	O	D	I	V	A
S	O	L	I	D		Z	E	E			G	R	A	T	I	S
T	R	A	N	S	F	O	R	M	A	T	I	O	N			
L	A	M	E		I	N	S		M	O	S	S		T	O	N
E	S	P		D	N	S		A	U	T	H	O	R	I	T	Y
			E	W	E		I	S	L	E			E	P	I	C
	H	E	T	E	R	O	S	C	E	D	A	S	T	I	C	
N	O	O	N			C	L	O	T		N	E	E			
P	A	N	A	M	A	H	A	T		T	I	E		E	A	T
C	R	S		O	M	E	N		M	A	M		E	X	P	O
			G	U	A	R	D	I	A	N	A	N	G	E	L	S
T	A	L	O	N	S			C	R	T		O	R	C	A	S
A	B	O	R	T	S		C	H	A	R	T	R	E	U	S	E
B	U	N	G	E	E		F	O	C	U	S		S	T	I	R
S	T	E	E	D	S		C	R	A	M	P		S	E	A	S

lookAHEAD

SUN NOV 19	MON NOV 20	TUE NOV 21	WED NOV 22	THU NOV 23	FRI NOV 24	SAT NOV 25
	MathSoc General Meeting Drop, penalty 1 period ends Drop/add period for Winter 2018 term begins	Drop, penalty 2 period begins	MathSoc Party with Profs	Thanksgiving (USA)		

SUN NOV 26	MON NOV 27	TUE NOV 28	WED NOV 29	THU NOV 30	FRI DEC 1	SAT DEC 2
	mathNEWS Production Night!	Bring food to the mathNEWS editors day			v135i6 of mathNEWS comes out. First day of your Christmas advent calendars.	