

M & E 2020

The University of Waterloo is sUsTainAbLy investing
over 61 million in the fossil fuel industry.



"DESCRIBE YOUR IDEAL FURSONA."

CONTRIBUTORS WERE ASKED TO DETERMINE THEMSELVES IF THIS MEANT THE FURSONA THEY WANTED FOR THEMSELVES OR THE FURSONA THEY WANTED TO FUCK.

Readers.

I am sad to say that the scourge of **mathNEWS** has once again returned to plague us. Which scourge, you ask? Why, it is but the deadly-yet-common phenomenon of poorly timed midterms.

Yes, plural midterms. I am told that both MATH 138 and MATH 237 decided to hold their midterms at the same time as production night, resulting in an attendance of under 15 contributors. (You may shed a tear now, in solidarity with all those who were present.)

Following that, **mathNEWS** has decided to file a formal complaint with the parts of the university administration who decide when to schedule midterms. It should be easy to find any weekday other than Monday! Especially considering production night isn't even every single Monday, but every other Monday. How is it that they keep lining up so terribly?

Anyways, this issue is much shorter than usual. I'm even running out of content to talk about in this **mastHEAD**.

I guess I'll talk about my own life now, which I sometimes resort to when this happens. See past volumes for tales of my embarrassing past. (Honestly, don't. It'll be a long search, and you won't get very much out of it unless you have an unhealthy obsession with the past lives of **mathNEWS** editors.)

This is my last term here with **mathNEWS**, and boy oh boy am I feeling old. I turn 23 in two weeks, and that's the first prime number since 19. 19 was much more exciting, since it marked the legal drinking age, among other things. This one just reminds me that I'm too old to have other people care about what age I'm turning anymore. As such, I have to celebrate my birthday myself, which will probably be in the form of working on assignments so that I don't fall any more behind in my courses than I already have. Such is life at the end of one's degree.

Well, that's all! Enjoy.

itorED
Editor, **mathNEWS**

swindLED
Editor, **mathNEWS**

DERIVINGFOR DICK		Flamingo.
ITSH		Like manbearpig, but with a wolf and a beaver. Manwolfbeaver.
SANDWICH EXPERT		Speckle from Tuca and Bertie.
FINCHEY		Bertie from Tuca and Bertie.
OCTOPODES		←
SKIT		Winston Overwatch.
SILLYCONE		A carrot.
SWINDLED		One that also fits the other interpretation of the question.
TERRIFIED		Something that won't get me permanently disowned by my parents.
ITORED		mathNEWS hat.
CONFUSED		Armadillo.

ARTICLE OF THE ISSUE

This week's Article of the Issue award goes to Vincent Macri for [Divestment: What was learned from a five month long mathNEWS investigation](#), and the two other related articles in this issue.

I know I often joke in this segment that we rarely get serious articles in **mathNEWS**, but the bar for serious articles has in truth gotten pretty high over the years, as we've slowly accumulated a corpus of articles ranging from in-depth political analysis, to well-needed critiques and commentary on events here at the university.

All that said, spending 5 months to do proper investigative journalism, including primary research and interviews, blows everything else out of the water. In fact, I think the ocean has been evaporated entirely. There's a good chance Vincent's article is also the record holder for most expensive **mathNEWS** article to produce.

Congratulations once again, and don't forget to swing by the **mathNEWS** office to claim your prize!

mathNEWS should count for midterm credit.

MIN ZHU, **mathNEWS** EDITOR FOR WINTER 2020
ALONG WITH JAMIE ANDERSON, TERRY CHEN AND ANUJ OPAL

WEIGHT LOSS TIPZ: FROM SOMEONE WHO IS TRYING

So we're two months into the new year and you've reached a plateau or you're back to your old ways, but you still want to lose weight. Here are some tipz to help you shed those extra pounds:

EXPERIENCE A PAINFUL BREAKUP

My past relationship was toxic to the T and I somehow magically lost 30 lbs in the span of 3 months. So get yourself one of those but be careful of the side effects.

GO ON A CALORIC DEFICIT

This one we all heard of, I've heard this many times before but abs are made in the kitchen. Basically the easy way to do this is take your current weight and multiply it by 10 then just eat less than that number and you'll see progress over time.

ALLOW YOURSELF A CHEAT DAY

Don't beat yourself up for not sticking to your diet, find ways to motivate yourself in a positive and healthy matter. Cheat days allow yourself to enjoy your favourite foods but in moderation.

SPICE UP YOUR WORKOUTS

Plateauing is very normal but it's not forever. One of the ways to break it is by changing your workout routine. Honestly, find a physical activity you enjoy doing like dancing, and before ya know it you just lost a few extra pounds without realizing it.

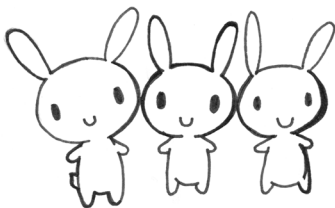
WORK ON YOURSELF

All of the painful breakups, caloric deficits, cheat days, and spicy workouts at the end of the aren't worth it if you aren't happy. So maybe take this time to just learn how to appreciate yourself and your body for everything it does for you.

—

At the end of the day, do whatever makes you happy, surround yourself with cool friends, as long as you're happy and healthy who cares how much you weigh? You don't need to add that additional stress in your life when you got midterms and soon after finals. Stress eating is very normal, more fun with friends though.

EXTRAverted



A FAREWELL TO THE MATHSOC SALES AND CHECKOUT SYSTEM

Through 2012 and 2013 under the sweeping business practice changes of then-Executive Ty Rozak, Lauren Hurley, and Elizabeth McFaul, MathSoc obtained a new sales system: the glorious Openbravo Sales software running on Windows XP. Why Windows XP in 2013 you may ask? Because that was the only OS in which the free Openbravo software was compatible, Openbravo was the only software that had (European) toonies, and it was the machine MathSoc still used for games sign-outs.

Thus in 2013 this software and its sales methods came into being. It was simple, yet straightforward, and sales were able to be conducted relatively quickly with very quick training. For nearly 7 whole years, this system was in place and sufficient to conduct all of MathSoc's business, with minor business hiccups along the way. And then Doug Ford came...

With the Ontario government's 2019 Student Choice Initiative laws, certain taxes for university organizations needed to be calculated differently. MathSoc's system needed to become compliant, and no one wants to deal with the pain that is modifying freeware to do what you need...and also...Windows XP...in 2019...or a sales system. This not only seems insecure, but just plain bad. WHO ELSE IS USING WINDOWS XP IN 2019/2020?! A new system (in development since 2015-ish) seemed up for the task, and after many a year, it finally entered the parallel testing phase at the end of January 2020.

Thus, on Wednesday, Feb 26th, 2020, the old XP machine is being turned off in favour of the new one...which has better security, a steep learning curve to use and is just a lengthy pain to sign out games with. It also means MathSoc's pricing will change slightly with black and white printing going from \$0.10 per page to \$0.09 + tax per page. On the outset, it doesn't SEEM that this is a bad change, but if you were to print 26 pages in black and white, you will be paying a nickel more as a result of this change (from \$2.60 to \$2.64 which rounds up because that's how taxes work). More importantly though, this system will be technically tax compliant and very much Doug Ford approved. MONEEEEEEEY...

MathSoc Office Staff have reacted with great sadness that ol' reliable Windows XP is going to be taken down, with many lamenting the loss of not only the wonderful sign-out system designed by alumnus Ford Pephrah, with modifications by Ho-Yi Fung, but the easy button method of Openbravo's sale searching. Who knows what the new system will really mean for future transactions and sign-outs, but one things for sure: Openbravo's and Ford Pephrah's system have served their purposes well.

Rest easy sweet software and Python-SQL database interface. MathSoc will no doubt miss you <3

DIVESTMENT: WHAT WAS LEARNED FROM A FIVE MONTH LONG mathNEWS INVESTIGATION

I started working on this article on October 4th, 2019. Almost five months ago.

I was sitting around my apartment one day, and a thought crossed my mind. “Is the University of Waterloo invested in fossil fuels?” So I decided to look into it. Nearly 150 emails later, and I have figured it out.

The top line is \$61.436 million, but there is more to it than that.

In November 2015, the Waterloo Environment Students Endowment Fund (WESEF) voted to divest (divest means stop investing) their endowment fund from fossil fuels.¹

Fast forward a bit, and the University put together the Responsible Investment Working Group (RIWG) which did some consultations and eventually adopted an ESG policy for investing. ESG stands for environment, social, and governance. Basically, when finance people say “ESG” they mean “ethics”. So prior to this, the university had no ESG policy for investing. The RIWG recommendations included²:

- formally adopt ESG factors as a valid and important lens to be integrated into investment decision-making processes;
- adopt the guiding principles and the guidelines for the application of ESG principles contained in the report;
- prepare for the University to become a signatory in good standing to the United Nations Principles for Responsible Investment;
- explore and evaluate potential social impact investments with the aim to launch a pilot investment in this space in one year's time;
- annually review progress on the implementation of these recommendations

Critics say that these recommendations do not mandate any specific concrete actions to be taken.

In 2017, the University released the following information (to see a breakdown by individual companies, see the citation) on its fossil fuel investments as of December 31, 2016. These numbers were based on investments in the top 200 companies that own fossil fuel reserves. This does not include smaller companies, or companies in the fossil fuel industry that do not own reserves (such as pipeline companies).³

“Top 200 Fossil Fuel” Equity Exposure As of December 31, 2016, in thousands ('000)

	REGISTERED PENSION	ENDOWMENT	TRUST	COMBINED
TOTAL EXPOSURE	\$40,294	\$27,253	\$872	\$68,419
TOTAL INVESTMENT	\$1,514,493	\$355,955	\$52,568	\$1,923,016
%EXPOSURE TOTAL INVEST	2.66%	7.66%	1.66%	3.56%

Since then, no more information on the university's fossil fuel investments has been publicly released, until now. **mathNEWS** filed a Freedom of Information request to get the University to release updated numbers.

As of December 31, 2019, the fossil fuel companies that the University held investments in per the 2016 release is now down to roughly \$32,777,000.⁴

However, in the process of filing the FOI, **mathNEWS** learned that the University is now creating quarterly reports on their exposure to the Energy Sector, but is not (yet) releasing them publicly unless requested. This includes more than just the companies that were invested in in 2016. It includes new fossil fuel investments, and investments in other fossil fuel industry companies which don't own any fossil fuel reserves themselves (such as pipeline companies), or companies that only own small amounts of fossil fuel reserves. This document revealed that the University still holds over \$61 million of investments in the “Energy Sector”. According to Tyler Wendland, Associate Director, Treasury at the University of Waterloo, an “energy” company is determined by the stock exchange the company trades on.

The following is the energy sector exposure report.⁵

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A mathNEWS EDITOR
WHO'S TOTALLY STILL
ALIVE INSIDE, PROMISE.

Investment Exposure in Energy Sector
As of September 30, 2019, in thousands ('000)

INVESTMENTS IN ENERGY (SPECIFIC INDUSTRY NOTED IN PARENTHESES)	PENSION	ENDOW- MENT	SPECIAL PURPOSE TRUST	TOTAL INVESTMENT
ARC RESOURCES LTD. (OIL & GAS)		\$277		\$277
CAMECO CORP. (URANIUM)		\$90		\$90
CANADIAN NATURAL RESOURCES LTD. (OIL & GAS)	\$3,042	\$2,767		\$5,808
CENOVUS NATURAL RESOURCES LTD. (OIL & GAS)		\$337		\$337
CNOOC (OIL & GAS)	\$5,318	\$1,198	\$642	\$7,158
ENBRIDGE INC (ENERGY TRANSPORTATION)		\$1,918		\$1,918
ENI SPA (OIL & GAS)	\$6,483			\$6,483
EOG RESOURCES (OIL & GAS)	\$5,256	\$1,184	\$635	\$7,074
IMPERIAL OIL LTD. (OIL & GAS)	\$3,852	\$2,057		\$5,908
KEYERA CORP. (OIL & GAS)		\$371		\$371
PEMBINA PIPELINE CORP. (ENERGY TRANSPORTATION)	\$2,163	\$1,612		\$3,775
PRAIRIE SKY ROYALTY LTD. (MINERALS, OIL & GAS)	\$4,009	\$2,143		\$6,151
SCHLUMBERGER (OIL & GAS)	\$3,691	\$832	\$446	\$4,969
SHAWCOR LTD. (OIL & GAS)	\$1,615	\$869		\$2,485

SUNCOR ENERGY INC. (OIL & GAS)	\$1,451	\$2,199		\$3,649
TC ENERGY CORP. (ENERGY TRANSPORTATION)	\$2,623	\$2,297		\$4,920
TOURMALINE OIL CORP. (OIL & GAS)		\$153		\$153
TOTAL INVESTMENTS IN ENERGY	\$39,501	\$20,302	\$1,723	\$61,526
VALUE OF INVESTMENT MANDATE	\$1,886,561	\$434,683	\$96,062	\$2,417,306
ENERGY SECTOR EXPOSURE	2.09%	4.67%	1.79%	2.55%

Exposure by Investment Manager

FIERA - NO ENERGY EXPOSURE	ENDOWMENT	TOTAL INVESTMENT
VALUE OF INVESTMENT	\$58,614	\$58,614
INVESTMENT IN ENERGY	\$-	\$-
ENERGY SECTOR EXPOSURE	0.00%	0.00%
MSCI WORLD INDEX ENERGY SECTOR EXPOSURE (BENCHMARK INDEX)	5.40%	5.40%
OLDFIELD (GLOBAL EQUITY)	PENSION	TOTAL INVESTMENT
VALUE OF INVESTMENT	\$152,186	\$152,186
INVESTMENT IN ENERGY	\$6,483	\$6,483
ENERGY SECTOR EXPOSURE	4.26%	4.26%
MSCI WORLD INDEX ENERGY SECTOR EXPOSURE (BENCHMARK INDEX)	5.40%	5.40%
PH&N (CANADIAN EQUITY)	ENDOWMENT	TOTAL INVESTMENT
VALUE OF INVESTMENT	\$42,624	\$42,624
INVESTMENT IN ENERGY	\$7,050	\$7,050
ENERGY SECTOR EXPOSURE	16.54%	16.54%
S&P/TSX COMPOSITE INDEX ENERGY SECTOR EXPOSURE (BENCHMARK INDEX)	16.50%	16.50%

SIONNA (CANADIAN EQUITY)	PENSION	ENDOWMENT	TOTAL INVESTMENT
VALUE OF INVESTMENT	\$111,628	\$61,126	\$172,754
INVESTMENT IN ENERGY	\$18,753	\$10,038	\$28,792
ENERGY SECTOR EXPOSURE	16.80%	16.42%	16.67%
S&P/TSX COMPOSITE INDEX ENERGY SECTOR EXPOSURE (BENCHMARK INDEX)	16.50%	16.50%	16.50%

WALTER SCOTT (GLOBAL EQUITY)	PENSION	ENDOWMENT	SPECIAL PURPOSE TRUST	TOTAL INVESTMENT
VALUE OF INVESTMENT	\$312,829	\$70,466	\$37,790	\$421,085
INVESTMENT IN ENERGY	\$14,265	\$3,213	\$1,723	\$19,201
ENERGY SECTOR EXPOSURE	4.56%	4.56%	4.56%	4.56%
MSCI WORLD INDEX ENERGY SECTOR EXPOSURE (BENCHMARK INDEX)	5.40%	5.40%	5.40%	5.40%

Moreover, this reveals that of the University's five investment managers, only one, Fiera Capital, does not invest in the energy sector. Fiera Capital is the only investment manager to be hired since the University adopted its ESG policy. Fiera Capital was hired to replace another investment manager. Tyler Wendland, Associate Director, Treasury for the University of Waterloo, declined to say which investment manager was replaced or why they were replaced, citing "legal/contractual reasons".

Math students who want to push for divestment can reach out too the MathSoc VPA (vpa@mathsoc.uwaterloo.ca), their MathSoc Councillors (mathsoc.uwaterloo.ca/council-members), and their WUSA Students' Council Math Representatives (wusa.ca/student-bodies/students-council). Students in other faculties can reach out to their faculty's equivalents.

All students can also reach out to the WUSA VP Education, Matthew Gerrits (vped@wusa.ca).

For students who want to get more involved, Fossil Free uWaterloo is a WUSA club that advocates for fossil fuel divestment. Fossil Free uWaterloo's website is fossilfreeuw.ca.

This investigation has shown that the University's adoption of an ESG policy has led to a small but noticeable reduction of fossil fuel investments in the endowment fund, and only a marginal reduction in fossil fuel investments overall.

Vincent Macri

1. <http://uwimprint.ca/article/environment-students-push-for-green-investments/>
2. <https://uwaterloo.ca/daily-bulletin/2018-06-06>
3. <https://fossilfreeuwca.files.wordpress.com/2017/12/investment-summary-top-200.pdf>
4. mathnews.uwaterloo.ca/wp-content/uploads/2020/02/FOI-Data.pdf
5. mathnews.uwaterloo.ca/wp-content/uploads/2020/02/Energy-Exposure-Report-as-at-Q3.pdf

PMATH/AMATH/C&O MATHSOC COUNCILLOR OFFICE HOURS

Are you a Pure Math, Applied Math, or Combinatorics and Optimization major who has academic concerns? Think a certain course is missing from the curriculum? Concerned that certain courses aren't being offered often enough? Have literally any complaint about anything related to your undergraduate experience? Then come to your PM/AM/CO MathSoc Councillor's office hours from 4:00–5:00pm every Tuesday in the PMAMCO Club room (MC 3033) and complain to me. I will bring your complaints to MathSoc Council, and hopefully get something done about it. If 4:00–5:00pm on Tuesdays doesn't work for you, then try coming by the PMAMCO Club room at any time. I'm usually there, especially in the afternoon and evening.

For other constituencies, refer to teamup.com/ks2e3xr-8n5aumyc48s to see when your Councillor's office hours are.

Vincent Macri

I wrote for mathNEWS → I get free pizza

A mathNEWS EDITOR WITH SOMETHING TO PROVE

DIVESTMENT: MY QUESTIONS FOR WUSA ENVIRONMENT COUNCILLOR GUY BRODSKY

Guy Brodsky is a third year student in the School of Environment, Resources and Sustainability. He was behind the motion at WUSA Student's Council that passed in November 2019, calling on WUSA to draft a policy regarding divestment of faculty endowment funds, and is a current Councillor Representative for the Environment Faculty on WUSA Students' Council. He is also involved with the Waterloo Environment Students Endowment Fund (WESEF) and Fossil Free uWaterloo (FFUW).

I reached out to Brodsky by email and asked him a few questions on WUSA's divestment progress.

What has been your involvement with divestment on campus?

"[I] have been involved with the divestment movement on campus through board positions on WESEF, where along with a couple FFUW members we had a promising meeting with the Dean of Environment to discuss options for divesting the environment endowment fund from fossil fuels (aka options for either taking it out of the main bundled fund or divert new voluntary contributions from students directly to [WESEF]-funded projects so that a portion of it is not invested in the fund which currently includes heavy carbon assets). Also, as you saw, I joined council to bring this clearly widespread opinion and sentiment about divestment to WUSA, as well as some of the lesser known facts about it."

What progress has WUSA made on drafting the divestment policy that Council voted for?

"Unfortunately EAC has not yet met for the [W]inter term. With some friends from WESEF and experience with [WUSA] policies we drafted an early piece on it for feedback and to get the ball rolling as I understand there is a lot on the plate of the committee, although nothing has been done yet. In the meantime I'm hoping to bring a sustainable finance or community foundation fund manager to come speak to WUSA council, and also restarting on another policy document but through FFUW. So far the community, including faculty and students from post-doc to undergraduate, seem very supportive, so its all the more frustrating to see no movement or commitment from the administration. The main plan right now is to continue educating students from the different faculties on the Climate Crisis, show up for the community, and focus on the purely financial arguments when it comes to dealing with the administration.

—

I have high hopes and a belief in our community, and am further inspired by divestment movements at McGill and Guelph just to name a couple, and of course the widespread solidarity protests for the Wet'suwet'en nation in BC currently defending their land from an armed and violent RCMP force."

Vincent Macri

A MILLENNIAL'S JOURNEY TO UNDERSTANDING ZOOMER CULTURE THROUGH TIKTOK

Hello, hi so I'm a person who is born the year 1997, this makes me borderline Gen Z but mostly a Millennial. However, I have a younger sister who is born in 2001 and she is the walking definition of a Zoomer, and I didn't get the jokes she makes half the time before I downloaded TikTok. I now understand how Boomers feel when they look at Millennials.

I've decided to download Tiktok for further investigation to understand Zoomers aka Gen Z. I was always a fan of Vine until it got shut down, and I was recommended TikTok as it is Vine but for Gen Z. I initially downloaded it as a joke but now I see what the hype is all about. Basically, TikTok is a social media platform where people share short videos ranging from dances, stories, advice, tips, cute animals, comedic skits, memes; the list goes on.

My experience with Tiktok for the most part has been pleasant as I had no expectations at the beginning, but now I find myself spending time on my spare time on TikTok or scrolling through it before bed. I can't help but forget that the

app's primary users are Gen Z, I still question how old high schoolers look nowadays.

I once used Tiktok as a medium for a job application and landed an interview the next day. I'd probably be lying to myself if I told you I wasn't addicted, but I am slowly coming down from the high. I also created a few TikToks of myself. Millennials need to give Zoomers more credit, technically they have more knowledge than us because they grew up in a time where the internet already existed. Maybe these kids are onto something. TikTok could be used as an education platform, I've learned some pretty useful stuff from it.

In conclusion, I would recommend Millennials to try TikTok at least once before judging it. I would not recommend **mathNEWS** to have a TikTok account however, please leave **mathNEWS** alone.

EXTRAverted

STAIRWAY CONSTANTS, PART [3,4.5]

FOREWORD AND CORRECTION

In last issue's *Stairway Constants* I rearranged $(i - j)\theta \approx 2k\pi$ to $\frac{2\pi}{\theta} \approx \frac{k}{i-j}$. I obviously meant to write $\frac{2\pi}{\theta} \approx \frac{i-j}{k}$ (divide both sides by $k\theta$). It doesn't change the rest of the argument about rational approximations.

If you're tuning into the *Stairway Constants* series for the first time, we're looking at the constants on the number line that was added to the MC north-northeast stairwell last year. So far we've covered the constants in the intervals $[0,1)$, $[1,2)$, and $[2,3)$; this issue we'll cover $[3,4.5)$. As always, it's highly recommended that you actually go to the stairwell with this article in hand, for a fully-immersive tour.

One thing this series mentions very frequently is the OEIS. "For more digits, see OEIS Axxxxxx." OEIS stands for the Online Encyclopedia of Integer Sequences (at oeis.org), and xxxxxx is a 6 digit code used to look up an OEIS entry. Yes, we need all 6 digits. Despite being restricted to only integer terms, the OEIS has enough sequences (over 100000) to fill a book as thick as this stairwell is tall.

However, many of the stairway constants are transcendental—what are they doing in a database of integer sequences? It turns out that there's a very simple correspondence between real numbers and integer sequences, so common that you use it every day without thinking.

For example, take Mills' constant (not in this stairwell). Its hypothesized value is 1.3063778838630806... and it has some really cool properties you should totally look into in your free time. The corresponding OEIS sequence is A051021, which goes

1, 3, 0, 6, 3, 7, 7, 8, 8, 3, 8, 6, 3, 0, 8, 0, 6, ...

Quite simply, the sequence is the base-10 digits of the constant. The uses of the OEIS go far beyond simply storing the digits of long numbers. For more about the OEIS, you can hear it from the man who created it, Neil Sloane. Check out the Numberphile Podcast with Sloane at https://youtu.be/mNk_MfFKnuY.

FLOOR 3

Three. The first odd prime number. The number of petals on this province's official flower. 3 non-collinear points in our 3-dimensional space uniquely define a plane containing 3 line segments that bound the simplest polygon: a triangle. Remarkable as it is, the number 3 lives in the shadow of its smaller cousin 2. Just look at this number line! $\sqrt{2}$ is here, but $\sqrt{3}$ isn't.

Being in the shadows doesn't mean that three can't be cool. Have you noticed how many meme numbers are divisible by 3? Here are a few:

- 21
- 42
- 69
- 420 (and 42069, and 69420)
- 666
- 9000
- 58008 and 80085 (but not 5318008 or 8008135)¹

Of course, a lot of meme numbers are divisible by 2 as well, but that just sounds stupid to point out. Divisibility by 3 is way more impressive because it's rarer, and you actually have to look at *all* of the digits to check (in base 10).

π

PI

3.1415926535...

(For more digits, see OEIS A000796.) π is probably the most famous constant of all time—even more popular than e . Just look at this number line! We've already seen the golden angle, which is derived directly from the golden ratio and π . Now here's π itself in full glory. Up ahead, about half of the remaining stairway constants are related to π .

π is prominent because it's so simple. Draw a circle. Draw a line perfectly through that circle. The edge of the circle—the circumference—is π times longer than the line through the circle—the diameter. See something round? π is probably involved. See something completely unrelated to circles? π is still probably involved. For example, Euler famously proved

$$\frac{\pi^2}{6} = \frac{1}{1} + \frac{1}{4} + \frac{1}{9} + \dots = \sum_{k=1}^{\infty} \frac{1}{k^2}$$

π is so prominent that it has become a symbol representing all of mathematics. Pi Day (March 14th) is an annual occasion for everyone to fire up their Twitter accounts and pretend to like math. MathSoc distributes certain baked pastry dishes with sweet or savoury fillings—also known as pies. Among the many Pi Day traditions is π recitation. The Guinness world record is held by Rajveer Meena with 70,000 digits, but Akira Haraguchi holds the unofficial world record with 100,000 digits! As a species, we didn't even know 100,000 digits until 1961. Since then, our ability to compute π has grown exponentially. Last month, Timothy Mullican broke the world record for π computation with 50 trillion digits. I'm kind of bummed about that, because the previous record was pure awesome: Emma Haruka Iwao computed exactly 31,415,926,535,897 digits.²

Exercise: Pi Day is on March 14th because we use a base 10 decimal number system. Is there a hexadecimal Pi Day? Which bases have Pi Days, and which do not?

Memorizing and computing digits of π are both extremely deep arts that have much more to them than meets the eye. Algorithms for computing π have been known for centuries before computers came along to use them. The

recent records were set using the Chudnovsky algorithm (Google that if you want to see a really long formula). Simpler but slower algorithms exist based on the Maclaurin series for the arctan function (in the range [-1,1]):

$$\arctan x = \sum_{k=0}^{\infty} \frac{(-1)^k}{2k+1} x^{2k+1}$$

For example, we can start from the equation $\tan \frac{\pi}{6} = \frac{1}{\sqrt{3}}$ and solve for π :

$$\begin{aligned} \frac{\pi}{6} &= \arctan \frac{1}{\sqrt{3}} \\ \frac{\pi}{6} &= \sum_{k=0}^{\infty} \frac{(-1)^k}{2k+1} \left(\frac{1}{\sqrt{3}}\right)^{2k+1} \\ \pi &= 6 \left(\frac{1}{\sqrt{3}}\right) \sum_{k=0}^{\infty} \frac{(-1)^k}{2k+1} \left(\frac{1}{\sqrt{3}}\right)^{2k} \\ \pi &= 2\sqrt{3} \sum_{k=0}^{\infty} \frac{(-1)^k}{3^k(2k+1)} \end{aligned}$$

Ignoring the problem of needing to know the precise value of $\sqrt{3}$, let's try using this formula to compute π . Summing the first 9 terms of the series already gets us 5 decimal places of precision: 3.14159. Can we do better? In general, the Maclaurin series for $\arctan x$ converges faster the closer x is to 0. "Machin-like formulae" use sneaky compound angle witchcraft to take advantage of extremely small values of x — they can converge at *ludicrous* speed.

But why does one even need that many digits of π ? There are some open mathematical problems that we still don't have enough digits of π to solve computationally. Here's one to scratch your head with. Prove or disprove: $3^{\pi^{\pi^{\pi}}}$ is an integer

$$\frac{22}{7}$$

3.142857143...

(For once, the OEIS doesn't have more digits of this constant. Why? It's rational; the sequence 142857 repeats endlessly.) A pink line connects the π plaque to the number line. Barely a finger's width to the right is another pink line connecting $\frac{22}{7}$ to the number line. Clearly, $\frac{22}{7}$ is an unreasonably good rational approximation of π .

The general relationship between continued fractions and good rational approximations is a recurring theme in this stairwell. To recap, a rational approximation of x is a fraction $\frac{p}{q}$ which is closer to x than any other fraction with a denominator no larger than q . We can always get better precision with a denominator larger than q , but that comes at the cost of way more computation.

In general, rational approximations for a number can be found by truncating its continued fraction at arbitrary points. For example, here are the continued fractions for π and the golden ratio:

$$\begin{aligned} \pi &= 3 + \frac{1}{7 + \frac{1}{15 + \dots}} \\ \phi &= 1 + \frac{1}{1 + \frac{1}{1 + \dots}} \end{aligned}$$

Let's truncate these continued fractions after the second coefficient:

$$\begin{aligned} 3.14159\dots = \pi &\approx 3 + \frac{1}{7} = \frac{22}{7} = 3.14285\dots \\ 1.61803\dots = \phi &\approx 1 + \frac{1}{1} = 2 \end{aligned}$$

On the number line, $\frac{22}{7}$ is off from π by the width of a finger, while ϕ and 2 are separated by a flight of stairs. How can the accuracy vary so much? If we reexamine the continued fractions, we can write them as

$$\begin{aligned} \pi &= 3 + \frac{1}{7 + \text{at most } \frac{1}{15}} \\ \phi &= 1 + \frac{1}{1 + \text{at least } \frac{1}{2}} \end{aligned}$$

By comparing the error terms, it's a no-brainer why π is so well-approximated whereas ϕ isn't. $\frac{1}{2}$ is over seven times larger than $\frac{1}{15}$. In general, a large coefficient (like 15) in a continued fraction is a sign that the previous rational approximation ($\frac{22}{7}$) is better than average.

Cutting off the continued fraction for π after the next coefficient gives us an even better approximation:

$$\pi \approx 3 + \frac{1}{7 + \frac{1}{15}} = 3 + \frac{15}{106} = \frac{333}{106} = 3.141509433\dots$$

However, because 15 is such a large number, the better approximation has a much larger denominator (106) than before (7). That's how we know that we had an amazing approximation before — even with a denominator of 50, you still can't do better than the short and simple $\frac{22}{7}$. Thus, people usually keep $\frac{22}{7}$ as the go-to rational approximation for π .^{4,5}

Exercise: prove that $\frac{22}{7} > \pi$ by evaluating the famous integral:

$$\int_0^1 \frac{x^4(1-x)^4}{1+x^2} dx$$

S
SILVER CONSTANT (SEVENTH BERAHA CONSTANT)
3.2469796037...

(For more digits, see OEIS A116425.) This constant is so obscure that even Wikipedia confuses it with the completely different silver *ratio*, which is $\sqrt{2} + 1 = 2.414\dots$ To find anything useful about the silver constant, we have to dig deep

into its second name: the seventh Beraha constant. What makes the seventh so important? After all, the first, second, third, fourth, fifth, and sixth Beraha constants weren't worthy enough to be on this number line. Or were they?

The Beraha constants are commonly denoted by B_n in mathematical literature, and there are infinitely many of them. They are defined by

$$B_n = 2 + 2 \cos \left(\frac{2\pi}{n} \right)$$

Exercise: show that $B_n = 4 \cos^2 \left(\frac{\pi}{n} \right)$.

$B_1, B_2, B_3, B_4,$ and B_6 are all non-negative integers, so they appear on this number line but without labels. Meanwhile, B_5 is exactly the golden ratio plus one, so it would be pretty redundant if it were featured in this stairwell—we already have the golden ratio.⁶

The silver constant is thus the first “non-trivial” Beraha constant: $B_7 = 2 + 2 \cos \left(\frac{2\pi}{7} \right)$. But why do we care about it anyway?

Sami Beraha introduced a very curious conjecture in his 1974 PhD thesis relating his namesake Beraha constants to graph theory. The formal statement of the conjecture is really esoteric, so I'm going to smooth over some details with an analogy. Suppose you had a 3-D solid constructed entirely from triangles (a tetrahedron, for example), and a paint palette with k colours. How many ways can you paint the faces using those colours, so that no two triangles of the same colour share an edge? According to graph theory, there exists a chromatic polynomial (a “chromial”) χ such that $\chi(k)$ is exactly the number of ways we can paint the solid with k colours. Different solids have different chromials, and different chromials have different roots. People care about roots, because $\chi(k) = 0$ indicates that it's impossible to colour the solid with k colours.⁷

Then we can ask really crazy questions, like what happens when we make $k = 4.2$, or $k = \pi$? Suddenly we're not talking about actual paints and colours anymore. Chromials, like all polynomials, don't care whether you plug in a whole number or not. Often, their roots are irrational.

Beraha's conjecture roughly states: “Roots of chromials like to hang out near Beraha constants.” That is, for any Beraha constant, you can find a solid whose chromial has a root arbitrarily close to that constant. A stronger version of the conjecture is that *only* Beraha constants have this property. As far as I know, neither conjecture has been proven or disproven.

Though the conjecture seems to have some implications in the study of magnetism, it's probably still too obscure to warrant featuring a Beraha constant on the number line. So what's it doing here? I'd bet that it's because Beraha constants are also known as the Tutte-Beraha constants. Wikipedia specifically calls S the “Tutte-Beraha constant” among other names.

“Tutte” refers to the late professor William Thomas Tutte, known best for his work cracking the “FISH” cipher at Bletchley Park during WWII. After the war, Tutte moved to Canada to perform remarkable research on graph theory. Bill Tutte might also be familiar to you because he is featured on the wall next to the MathSoc office in recognition of his contributions to creating the Faculty of Math, and later the Department of Combinatorics and Optimization (including its logo). This stairwell might very well not exist without professor Tutte, so the silver constant is a fitting tribute for the legendary mathematician.⁸

FLOOR 3.5

11 steps, as usual. What a stretch of constants that was! There's another one to your left.

Ψ

RECIPROCAL FIBONACCI CONSTANT

3.3598856662...

(For more digits, see A079586.) Leonardo of Pisa, or “Fibonacci” as he was later named by historians, is most famous for the Fibonacci sequence (OEIS A000045), which goes 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, etc. The Fibonacci numbers F_n are generated by the rule “add the last two terms to get the next” starting with $F_0 = 0$ and $F_1 = 1$. For example, the next term after 34 is $21 + 34 = 55$. Connected to the golden ratio, Fibonacci numbers show up in all sorts of unexpected places in mathematics.

The reciprocal Fibonacci constant is the sum of the reciprocals of all nonzero Fibonacci numbers:

$$\frac{1}{1} + \frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \frac{1}{5} + \dots = \sum_{k=1}^{\infty} \frac{1}{F_k}$$

As David Jao once told me, one of the reasons we care to calculate a sum of reciprocals is to see how quickly a sequence grows. The faster it grows, the faster its reciprocals decrease. If they decrease fast enough, the series converges to a real value (otherwise, it blows up to infinity). In this case, that real value is an irrational number slightly less than 3.36.

Exercise: the Brady numbers (OEIS A247698) are defined by the same “add the last two terms to get the next” rule, but they start with different values (2308 and 4261). What is the reciprocal Brady constant?

FLOOR 4

Four. Seasons, blood types, rocky planets, beats per measure. Four stairway constants between 3 and 3.5. In the 11 steps between 3.5 and 4, there were none. How strange? At least we have a fourth floor. You might be familiar with some buildings in Waterloo that don't have a fourth floor—not because they are too short, but because 4 is associated with death in various East Asian languages.

$$\sqrt{\tau e} = \sqrt{2\pi e}$$

SQUARE ROOT OF ($\tau \times e$)

4.13273135412...

(For more digits, see OEIS A019633.) If you're confused why there's an equals sign in this constant, it's because there are two ways of writing it. As we'll cover later, tau (τ) is defined as 2π . If you're confused why this constant is here in the first place, you wouldn't be the first. The only reference I can find to $\sqrt{\tau e}$ is in Steven R. Finch's book *Mathematical Constants*, which seems to be the go-to book about constants. Bear with me, this will take quite some explaining...

Let ω_n be the "volume" of the unit ball in n -dimensional space. (A unit ball centred at a point O is the set of all points within a distance of 1 from O .) For example, $\omega_2 = \pi$ is the area of a circle with radius 1, and $\omega_3 = \frac{4}{3}\pi$ is the volume of a sphere with radius 1. The volume peaks at 5 dimensions (more on this later in the stairwell). From $n = 6$ dimensions onward, ω_n diminishes to zero. $\sqrt{\tau e}$ arises when we try to quantify exactly how fast the volume decreases.

But wait, why does it even go to zero? To help your intuition, imagine putting the unit ball inside an n -dimensional cube with side length 2. How far are the corners of that cube from the centre of the ball? If the ball is centred at the origin $(0, 0, 0, \dots, 0)$, then the corners of the cube are at $(\pm 1, \pm 1, \pm 1, \dots, \pm 1)$. According to the Pythagorean theorem, the distance from any corner to the origin is $\sqrt{(\pm 1)^2 + (\pm 1)^2 + (\pm 1)^2 + \dots + (\pm 1)^2} = \sqrt{1 + 1 + 1 + \dots + 1}$. There are as many 1's in that sum as there are dimensions, so the distance is \sqrt{n} . As we increase the number of dimensions, this distance grows to infinity!

If we started at the origin and travelled to a corner of the box in a rocket ship, we would have to go \sqrt{n} units of distance. After the first unit, we'd already be outside the ball. The rest of the trip ($\sqrt{n} - 1$ units) is spent travelling through space that isn't part of the ball. In 4 dimensions, that's just half the trip. In 9 dimensions, that's two thirds. In 1 million dimensions, we're outside the ball for 99.9% of the trip! Hopefully, now you have a feeling for why the unit ball's volume approaches zero in higher dimensions. The amount of space inside the box becomes unfathomable, and the sphere takes up less and less of it.

If you're still in doubt, there is an exact formula for the volume:

$$\omega_n = \frac{\pi^{\frac{n}{2}}}{\Gamma(\frac{n}{2} + 1)}$$

The gamma function $\Gamma(x)$ is like a continuous version of $(x - 1)!$, so you can think of this informally as

$$\omega_n = \frac{\pi^{\frac{n}{2}}}{(\frac{n}{2} + 1 - 1)!} = \frac{\pi^{\frac{n}{2}}}{(\frac{n}{2})!}$$

Fun fact: when you tell Desmos to graph $x!$, it actually graphs $\Gamma(x + 1)$. The problem is, factorials are a pain to compute.

Fortunately, something called Stirling's formula gives us a very good approximation of $x!$:

$$x! \sim \sqrt{2\pi x} \left(\frac{x}{e}\right)^x$$

(By coincidence, Stirling's formula says $e! \sim \sqrt{\tau e}$.) The \sim symbol means that the ratio between $x!$ and Stirling's approximation approaches 1 as x increases. We can use this to approximate ω_n :

$$\begin{aligned} \left(\frac{n}{2}\right)! &\sim \sqrt{2\pi \frac{n}{2}} \left(\frac{\frac{n}{2}}{e}\right)^{\frac{n}{2}} = \sqrt{\pi n} \left(\frac{n}{2e}\right)^{\frac{n}{2}} \\ \omega_n &\sim \frac{\pi^{\frac{n}{2}}}{\sqrt{\pi n} \left(\frac{n}{2e}\right)^{\frac{n}{2}}} = \frac{(2\pi e)^{\frac{n}{2}}}{\sqrt{\pi n} (\sqrt{n})^n} = \frac{(\sqrt{\tau e})^n}{\sqrt{\pi n} (\sqrt{n})^n} \end{aligned}$$

Look at the numerator. $\sqrt{\tau e}$ has appeared!

FLOOR 4.5

11 steps brings you within view of a big pink 4.5, and a silvery plaque just to the right of it. Unfortunately, that's not part of today's menu. Next issue, I'll finish covering that constant and all the rest of them up to the seventh floor. Until then, good luck on midterms!

water

Exercise: don't take the elevator.

1. (I'm sorry)
2. These records are according to <http://www.numberworld.org/y-cruncher/records.html> which we have visited before in this series.
3. This came up originally in a Tweet (<https://twitter.com/sigfpe/status/330415672549068800>). Conner Davis showed on Quora (<https://www.quora.com/Why-is-it-unknown-whether-4-pi-pi-pi-pi-pi-is-an-integer/answer/Conner-Davis-2>) that the brute force method of the disproof requires π to be known to at least 630 quadrillion digits (more than 12 thousand times more digits than the current world record).
4. Of course, most people (even engineers) actually just hit the π button on their calculator, or write 3.14. For the record, $\frac{22}{7}$ is about 20% more accurate than 3.14.
5. An idiot named Edward J. Goodwin once tried to get the state of Indiana to legislate a bill accepting an incorrect proof. The proof implied among many other falsities that $\pi = 3.2$. Indiana was saved from being ridiculed off the face of the Earth by the hero Professor Clarence Abiathar Waldo, who gave the senators a proper education before they voted.
6. In *Mathematical Constants*, Steven R. Finch alleges that this correspondence between B_5 and the golden ratio is ultimately why B_7 is called the silver constant.
7. A few years after Beraha's conjecture, one of the most famous problems in graph theory was solved. It asked (roughly) whether or not 4 is a root of any chromial.
8. There is no way I can do justice to Bill Tutte's accomplishments in the space of this article. You can read about him in depth at <https://waterloo.ca/combinatorics-and-optimization/about/professor-william-t-tutte/biography-professor-tutte>

👏👏 FLAG REVIEW 6: PRESIDENTIAL PRIMARIES EDITION 👏👏

I have received some suggestions to review US state flags. I was hesitant in doing so because these flags have been reviewed by others before, and because I couldn't easily decide which out of the 50 states to review. There's also the fact that looking at some of these flags for a long time should be considered as torture. However, with the 2020 Democratic Party Presidential Primaries underway, I know which states to review, for better or worse. So, here are the flags of the four early primary states.

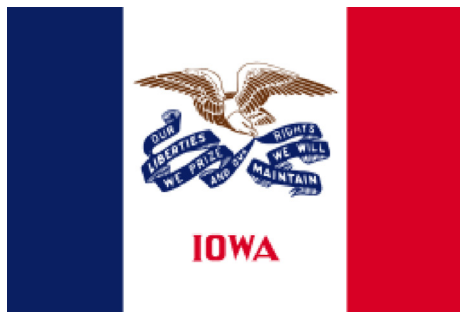
Viewer discretion is advised.

Here is my rubric, like before:

The flags will be scored out of 10 stars, with five of those being my holistic subjective score, and the other five being based on each of the five basic principles of flag design as defined by the North American Vexillological Association (NAVA). They are:

- Keep it simple
- Use meaningful symbolism
- Use two or three basic colours
- No lettering or seals
- Be distinctive or be related

IOWA



Let's save the good news for the end. The blatantly obvious problem: the giant red IOWA on the flag. Text is always a signifier of bad design, and if that wasn't enough, there's the entire state motto that the bald eagle is holding by its talons.

The good news is that, unlike some of the flags down this list, Iowa did not just put its state seal on a blue background. Instead, they actually used only the distinct element of the bald eagle holding the motto. Amazingly, they also made the

eagle monocoloured, instead of the brown gradient found on the seal. This was due to an update to the flag in 2018 which greatly simplified the colouring. However, there is still significant room for improvement, such as getting rid of the text and simplifying the eagle for better focus.

One element of this flag that needs no change is the tricolour. Iowa is situated in the once French Louisiana Territory, so the flag makes a clear historical link. The widths of the tricolour are not equal, but instead 1:2:1 like in the Canadian flag. The one problem I see is that the 1:2:1 ratio doesn't fit in well with the 2:3 ratio of the flag itself. Perhaps something in the range of 1:2 to 3:5 would work better, as that way there can be more space to work the eagle in.

It's a bad flag, but not the worst. Let's hope a better flag comes around before Iowa potentially loses its early primary status.

Design Score: ★☆☆☆☆

Subjective Score: ★☆☆☆☆

NEW HAMPSHIRE



It's the state seal on a blue background. That pretty much demolishes its score, but I must give them credit for not including "NEW HAMPSHIRE" in bold white lettering. However, if you look closer, it says "New Hampshire" in the seal, so credit revoked.

This lack of creativity cannot be blamed on a lack of inspiration. New Hampshire is one of the 13 original states, so surely it can use something from its centuries of history ...right? The ship seen on the seal, the USS Raleigh, has been a consistent feature on seals of the past. They should have promoted the ship and its accompanying historical importance onto the flag itself, rather than confining it.

I must say, that out of all the state seal + blue background state flags, this one is the least terrible. Sure, it's a really low bar, but credit is due where credit is due. I can't bring myself to actually give them a star for it though.

Design Score: ☆☆☆☆☆

Subjective Score: ☆☆☆☆☆

A feature is just a documented glitch.

PROF. IAN MUNRO

NEVADA



We can see right away that this is not too different from the usual bad state flag designs. However, what you see in the top-left corner is surprisingly not Nevada's state seal. It's a different emblem, made up of components that represent the state.

First, the words. We see two lines of text, one saying "Nevada" and one saying "Battle Born." The former is obvious, the latter less so. The phrase "Battle Born" is, confusingly, not the state motto. It arises from Nevada joining the union during the American Civil War. The actual state motto, "All for our country", is found on the state seal, which is thankfully absent from the flag itself.

Next, we have the silver star in the middle of this emblem. It represents Nevada's nickname—the Silver State. Silver was an important part of the state's early history. The sagebrush with yellow flowers to the sides of the star is the official state flower.

So, we can see that Nevada has done some proper work in designing its flag, but did they need to squish all the meaning and detail into the top left corner? It's designed like it's the central focus of this flag, so they should have put it in the centre. The blue background also needs to change, considering the amount of other awful state flags with blue backgrounds. Lastly, the words need to go. Replace them with more unique and identifying features of Nevada.

It's a better flag in terms of originality, but only compared with the other blue background + state seal flags. With a little more work I can definitely see this turn into something better. It still gets no stars from me though.

Design Score: ☆☆☆☆

Subjective Score: ☆☆☆☆

SOUTH CAROLINA



Finally we see something different! Let's first point out just how much simpler this flag is, compared to the others. Two symbols on a blue background. This state flag pays homage to earlier designs and to the state's history. From the first flag created during the American Revolutionary War, there has always been a crescent in the top left corner. Thankfully, South Carolina had learned, since then, to remove the word "Liberty" inscribed within it. This is the only state flag to prominently feature a crescent; most flags tend to have stars everywhere. That makes the first of many reasons why this flag is unique.

The tree in the flag's previous iterations changed colour, but it has mostly stayed white through history. Called a palmetto, it is native to the region and is also the state tree. It was added to the flag during the American Civil War, referring to a story in which, because of the palmettos surrounding a fort, it withstood an attack during a crucial battle. It's another unique identifier for the state.

The use of these two elements make this state flag unique, and the designers should be proud. There is no state seal on a blue background, the state's name or year of establishment. There is no way that this flag will be confused with one of another state. This is a lesson for all the other states with bad flags. I cannot stress this enough.

I left the colours to the end here, even though I usually get to it early. This is because South Carolina does not have specifications or regulations on how the flag should be constructed. There's no specified blue to use for the background. No specific shape or design for the tree or crescent exists either. It's up to the artist to decide what shade of blue to use, how the two elements should be placed, and how they should look. How everyone collectively decided to go with a slightly dark blue to use on Wikipedia's version of this flag is astounding.

It's like the former International Prototype Kilogram (IPK), from which all other reference kilograms were referenced. Most flags will have a history of flag nerds correcting each other and updating the flag over time to its exact specification. Not this flag, as one can't easily know its origins.

There is an IPK equivalent for the South Carolina flag somewhere. It's most likely lost to history, but because South Carolina currently has no design specification for its flag, all flags you encounter will all be slightly different in their own way. I think that makes each flag special and unique.

Design Score: ★★★★★

Subjective Score: ★★★★★

I have thankfully gotten state flags out of my system and I hope I don't have to review any more of them any time soon. Too many of them are just bad, and they get reviewed by pretty much everyone anyway. I'll spare myself the torture and focus on other flags.

Honestly, states with well designed flags should go first in the primaries. That way the public won't be subjected to bad flags for months. I'm hyped for Super Tuesday, because we won't be constantly bombarded with the same bad state flags in the media. Get all states with bad flags to have their primaries last. Spare all of us from witnessing the horror.

For the next **mathNEWS** issue, I'm uncertain as to which set of flags I should review next. I'm leaning on flags of Ireland, but that may change. As always, you can send in flags for me to review too. Bonus flags never hurt anyone.

boldblazer

PS: Bernie 2020!

DJAO:

“djao,” the man mustered through tightly gritted teeth. The worry lines on his face crease and his chest hair loses its luster as a rumbling begins to stir, though from exactly where, I can't tell. Glass bottles clatter against the shelf, and the man's head darts around in a panic. “I knew this would happen; I'm sorry,” he yells. The rumbling grows stronger and some drinks on the shelves tumble down, bottles shattering on the wooden floor: yet more Beyond Water beyond wasted. The building is shaking now, and it's no doubt coming from beneath us, amplifying with each passing second in a crescendo. “You knew what would happen!?” I yell back his way. Paralyzed, I see the man make a beeline for the door before finally He, the great beast with a spiky bowl cut, ascends through the earth and foundation beneath my feet as if summoned only by the meager utterance, powering through the building in a singular visceral instant. The story's in third-person now, because calling me dead at this juncture would be an understatement.

Omniscient now, we know this fiendish brute to be Prof. David Jao, otherwise known as “djao”. Liquid power and ASCII surge through his arteries, veins and capillaries, all the way down to his fingertips. Hold on, I have just been informed that this is just a description of the average Linux power-user. Still applicable to djao of course, but perhaps less tailored. In his right arm he holds his signature feared Elliptic Curve Isogeny: it glows and radiates supersingular energy, color indescribable with our limited vocabulary. With the other arm, he swipes through the rubble of the pub and surrounding buildings, in a ruthless wide swing, using principles of optimization in an attempt to locate our friend Ken and finish him for his transgression. But alas for djao, after discerning through the fallout, Ken is nowhere to be found. In a fit of rage, djao sends a wave of asymptotes.

The ball is in your court, supermagicTesseract!

jeff

TIPS FOR HELPING THE ENVIRONMENT! FEAT. SOME RANDO ENV KID

Hi! This is your friendly neighbourhood Environment Student! In a rare crossover between **mathNEWS** and some ENV kid, we present: Ways to Improve the Environment! Because even if ultimately it's the corporations that end up wasting so much we doom the next generation of depressed engineers, it still helps to do our part!

- You know what? Forget paper or plastic straws, use metal! You can even wash it after with a pipe cleaner or something. Save the turtles, sksksksk
- You know what's even better? Use pasta as a straw!
- You know what's EVEN BETTER? Just fucking drink it like it's from a cup. Take the stupid lid off and save the hassle, geez.
- We have three newspapers in UW: Imprint, **mathNEWS** and Iron Crusader (sic). To save paper, let's terminate the two lesser important ones.
- Napkins go in the COMPOST and NOT THE RECYCLING. It says it right there. If you put napkins in the recycling then we will sic our goose army onto you.
- Don't know what to do with straw wrappers? Are they paper, garbage, organic? Simple! If it's plastic, it's garbage. If it's paper, eat it.
- There's a ton of buildings that use exorbitant amounts of heating. (Look mom! I learned a new word!) Why not just...turn the heating off and let everyone freeze?
- Limit your use of single use plastics! This includes wrappers, plastic straws, condoms and balloons, and can even be extended to include masks. Sorry, but it looks like you'll have to deal with coronavirus.
- Hey, why the hell can't we eat geese? It's local and sustainable because there's SO DAMN MANY
- Forget eating geese, eating the rich is way better!

An ENV kid who snuck into the **mathNEWS** office

For the record, although I did once say “there is beauty in mathematics”, I did not then add “and it is me”.

STEPHEN NEW

SONIC THE HEDGEHOG 2: MOVIE LEAKS

So *Sonic the Hedgehog* came out in theatres on Valentine's Day, two weeks ago, and I was gonna write an article about it for the previous issue (which incidentally also came out on Valentine's Day), but instead I spent my time writing some dumbass, unrelated fever dream shit that wasn't even topical so what was the fucking point? But I digress: I didn't get to write it because I ran out of time. It was gonna be a short little history on the development on the movie, and summarize fan reactions over time and shit like that. Y'know, stuff anyone would pick up after following this movie since it was announced by Sony Pictures six years ago. But for all the uninformed masses out there—guess now you'll never know.

I watched the movie with a certain Sandwich Expert last Wednesday, and it was really very serviceable. It was on the level of *Detective Pikachu*—not that I watched *Detective Pikachu* (I don't give a rat's ass about Pokemon), I'm just going off ratings. A lot of people are speculating that a sequel will be greenlit—and I'm here to tell you that they're right.

How do I know? Clairvoyance. It's how I write the **horrorSCOPES** column. What, did you think I just pulled things out of my ass for those? I've got standards and INTEGRITY, motherfucker.

And innit your lucky day, because I've also used my amazing foresight to learn details of the *Sonic the Hedgehog* movie sequel that no one, not even the production team, knows about yet:

- Dwayne “The Rock” Johnson will have a voice-acting role.
- [REDACTED], who was introduced in the post-credits scene of the first movie, will play a major role in the plot.
- In response to critics' reviews of the first movie which acclaimed Jim Carrey's performance as Dr. Robotnik, the sequel will feature more screentime with Jim Carrey. Solo Jim Carrey scenes will take up 75% of the movie's 2h 40min runtime. Jim Carrey will also not be playing Robotnik, but as himself. The character “Dr. Robotnik” will never be mentioned.
- One of the alien worlds introduced in the first movie is a planet teeming with mushrooms across its entire surface. It will be revealed that the planet actually has human-like inhabitants; it is here that Mario from Nintendo's Mario franchise will make a cameo. In the first trailer for the movie, Mario will be depicted by a live actor wearing a costume—people will complain that Mario's teeth are too “human-like” for a cartoon character, and Paramount will delay the movie's release by six months to replace all shots of Mario with a newly-created CGI model. The CGI model will be designed by Shigeru Miyamoto himself.
- The chaos emeralds will be a key plot element, although their origin will never be explained, just like in the games.

- The sequel will take place after a two-year timeskip, when Sonic is fifteen years old and enters teenage rebellion. Tom and Maddie, his adoptive parents from the first movie, appear briefly in the opening scene before Sonic runs away from home.
- Sonic Drive-In will pay egregious amounts for product placement, and it will be egregiously shoed-in. Product placements will take up around 15% of the movie's screentime.
- The group of echnidias that attack Sonic and Longclaw at the beginning of the first movie will reappear in the sequel. Ken Penders will sue.
- In the middle of the credits, Dwayne “The Rock” Johnson's voice can be heard narrating. The screen will quickly cut over to reveal a red anthropomorphic echidna surveying the quaint town of Green Hills. Dwayne “The Rock” Johnson will voice Knuckles and he will say “holy fuckles it's me, Knuckles” before the rest of the credits roll, leading audiences all over the world to anticipate a third movie in the Sonic series which will adapt the third game in the franchise, *Sonic the Hedgehog 3 & Knuckles*.

Finchey

AN IDEA FOR THE NAME OF AN AMALGAMATED WATERLOO REGION

I realized recently that we don't need to debate about what entirely new name a hypothetical amalgamated Waterloo Region would be called. We can decide on a name based on precedence already set in Ontario.

Similar to the already existing United Townships of Dysart, Dudley, Harcourt, Guilford, Harburn, Bruton, Havelock, Eyre, and Clyde; we can name an amalgamated Waterloo as something along the lines of the United Region of Waterloo, Kitchener, Cambridge, Woolwich, Wilmot, Wellesley, and North Dumfries.

Additionally, like how the former is shortened to Dysart et al, the latter can similarly be shortened to Waterloo et al. What would be even better is that this new name for Waterloo would also beat Dysart et al's record of 61 letters or 68 non-space characters, to become Canada's longest place name.

Or we can go with calling it just Waterloo.

boldblazer

N BOPS TO LISTEN TO FOR STRESSED, DEPRESSED GAYS AND GIRLS (AND NON-BINARY PEEPS AND BOYS TOO I GUESS) FROM A STRAIGHT CIS GIRL

Recently I've been finding new music to listen to from literally anywhere whether it's those cool fandom edits you randomly find in your Instagram explore feed from random K-pop Stans or Riverdale watchers or Tik Toks (you'd be surprised to see how much cool music you can find from Tik Tok to be honest) or even just Youtube videos. From finding all this cool music from various genres, I present to you: **“N bops to listen to for stressed, depressed gays and girls (and non-binary peeps and boys too I guess) from a straight cis girl” (IN NO PARTICULAR ORDER TBH)**

1. *Lo Que Siento* by Cuco—a very nice dreamy song with an indie vibe to listen to that I most definitely found through Tik Tok. This song is great to listen to at night while studying or on your morning commute to class, it just calms you down nicely.
2. *True Colors* by The Weeknd—Abel Tesfaye, more commonly known as The Weeknd has been one of my all time favourite artists from the R&B/Soul genre since the start of me becoming an avid R&B listener. He do be Canadian too doe so eh !! *True Colors* (spelled without the 'u' for some unknown reason) is a great song to listen to when you're in love or you are a single rat that's just very into the idea of being in love. This is my all time favourite song by him and it's just such a great song to listen to when you're driving out from sunrise to late at night and you just want to sing along.
3. *Hex* by 80purpp—This song is a song I found from YouTuber Mai Phammy's outro and (this is the most zoomer sentence but imma throw it in here anyways) it's just such a vibe. This song is great for when you want to start off your solo dance party in your room with something calm. It's a short but fun song to listen to for sure.
4. *Ordinary Superstar* by Rina Sawayama—An absolute bop that you **need to enjoy**. This song is always a great one to sing to with pals on a late night drive through town or when you explore the streets of Toronto at night on your own. If you don't like this song you're homophobic PERIOD
5. *Vintage* by Niki—If you don't already know Niki, you've 100% been living under a rock or you haven't heard *Indigo* enough times through Tik Tok. *Vintage* is a song you can't like..not dance to, it's such a catchy song that I guarantee you will have on repeat often. If you don't find the beat of the song too interesting, I promise you that Niki's beautiful vocals make the song amazing and worth the listen.
6. *Candy Choppa* by warrenisyellow & Chasu—Candy Choppa has an addictive beat combined with a cool rap that you'll enjoy while you think about how much you miss the warm, sunny summers while you're stuck in the freezing cold in the dead of winter in Waterloo.
7. *Love Talk (English version)* by WayV—WayV is the Mandopop unit of a boy group by the name of NCT with 21 members under the South Korean entertainment label: SM Entertainment. Unfortunately, I do not speak or understand Mandarin but the English version of *Love Talk* is great to listen to. From Hendery's “falling for a stranger, good gracious” to the catchy line “I can hear it callin' from where you are. Loving the way you wanna talk” : you'll find that this song is so catchy. There's no way that you won't get addicted to this phat bop for months.
8. *Blueberry Faygo* by Lil Mosey—I have absolutely no clue what Lil Mosey is saying for half of this song but that doesn't mean this song isn't a bop. My life has not known peace ever since I heard this song from a Charli D'Amelio Tik Tok, but I'm not complaining. The beats from this song are just so damn good. The lyrics make no sense to me but IT'S FINE IT'S FINE IT'S FINE IT'S A GOOD SONG OK JUST TRUST ME ON THIS.
9. *Sweet Talk* by Saint Motel—You may have heard Saint Motel's music from David Dobrik's vlogs but I actually found *Sweet Talk* through an Instagram story post my friend Mabel had posted once. *Sweet Talk* is an incredibly addictive song, even if you're not too big on indie pop you should definitely give *Sweet Talk* a listen. Everything from the melody to the lyrics make you feel so alive, it's a perfect song to play on a summer road trip or when you're just walking around campus in between classes.
10. *Grow* by HOAX—This song is a bop I found from a recent video upload from YouTuber Bestdressed's channel! *Grow* is a song that'll make you feel like you're in one of the happiest scenes of a Coming-of-age movie. It's a song that gives off so much positive energy, you can't be sad as you listen to it or that'll throw off the mood. It **really** makes you wish it was summertime.
11. *Built That Way* by Emotional Oranges—Emotional Oranges is a very weird name for an R&B music group, I'll admit that for sure. If you haven't heard their music already, you have to check out *West*

Coast Love and *Built That Way* for sure. Emotional Oranges' soft vocals blend in the most lovely way in their music and the fact that I hadn't heard of them until **this year** is WACK Y'ALL. If you're a big fan of R&B/soul, you'll definitely need to give them a listen or you're doing the genre a disservice I PROMISE YOU.

12. *Tia Tamera* by Doja Cat & Rico Nasty—As much as I am convinced that Doja Cat is pretty bad at performing live, no one can deny that she is a strong woman who makes the catchiest music. *Tia Tamera* is such a great **bad bitch anthem**. If you haven't heard *Tia Tamera* you are missing out on so much. The lyrics are incredibly odd but it just adds to the greatness of this bop. Rico Nasty's feature on this track was the **perfect** artist of choice because she strengthens the song so much. If you need a song to bump to while you're fake getting ready for those parties that you don't really have time to go to because you're a UW student, THIS IS AN ESSENTIAL.

13. *Money In The Grave* by Drake ft. Rick Ross—I MEAN WHERE THE FUCK SHOULD I REALLY EVEN START? I have never been big on Drake's music, in fact I really only like about 3 of his songs to be honest. This song is so amazing though. It's a song that is essential for fun car rides or parties. It's incredibly catchy and timeless.

14. *Worldstar* by Childish Gambino—This song is my all time favourite song by Childish Gambino.

So many parts of this song are amazing from “my girl ain't bad, she more like evil” to “brrr, money counting. brrrr, ak, brrrr” THIS SONG IS JUST SO GOOD. Definitely a god tier hip hop song in my books. I have no complaints.

15. *I Didn't Just Come Here To Dance* by Carly Rae Jepsen—Is this really a list of bops for gays and girls (+ non-binary peeps and boys I guess) if I didn't include either a Carly or Lady Gaga song? NO. This is one of my favourite yet under appreciated songs on the *Emotion* album. While *Emotion* is undoubtedly one of the best pop albums from my youth, *I Didn't Just Come Here To Dance* is such a fascinating way to place towards the end of the tracklist on the album. It just *hits different*. This song is perfect to listen to with friends or even on your own if you're a loner! It really do be like that sometimes.

These are just 15 of many songs to give a listen that I've found through the power of the internet, finding new music and testing the waters of different genres is always a great idea because of how unique music can be as an art form. Try listening to some of these songs on your own time or on your way to class or something like that, I don't know man. I'm just trying to say that you should try to listen to some new songs you haven't heard yet. Who knows? Your next favourite song might be on this list.

Until next time,

HOE Chi Minh

MATH MAJORS AS ONOMATOPOEIAS

Act Sci – achoo

Applied Math – honk

C&O – slurp

CFM – pop

Computational Math – moo

CS – ew

CS/BBA – slosh

Data Science – choo-choo

FARM – cheep

Math/BBA – gong

Math/Business – buzz

Math/CPA – screech

Math Finance – coo

Math Physics – jingle

Mathematical Studies – cock a doodle doo

Math/Teaching – chortle

Pure Math – yip

Software Engineering – lurch

Statistics – belch

Undeclared – swish

pew pew

HOW TO GET AN ARTS MINOR, PT 1

I've given a collection of arts minors a rating out of 5 based purely on the structure of the course requirements, NOT the content of the courses. Minors get points for not being too restrictive while still providing a roadmap to make sure you actually know what you're doing. This list is incomplete; more to come!

ANTHROPOLOGY

8 courses with a cumulative average of ≥ 65 , including ANTH 201, ANTH 202, and ANTH 204

The three required courses cover the prerequisites for almost every other ANTH course, giving you freedom to do whatever you want for the other 5 courses. Good combination of making sure you're taught core concepts while giving a lot of freedom.

★★★★★

APPLIED LANGUAGE STUDIES

4 APPLS courses and 4 language courses in a single language which is not the student's first language, or 2 language courses in each of two languages which are not the student's first language, with a cumulative average of ≥ 65 .

Note that there are only 4 APPLS courses, so you'll be taking them all. Because of this, and the fact that language courses tend to be very linearly structured, there is little choice involved other than deciding what languages you are interested in learning. Also, if you take one course in a language and decide you don't want to pursue it further, it doesn't count towards this minor at all. Fun fact: there's both a minor and a diploma in applied language studies, but as far as I can tell they have exactly the same requirements.

☆☆☆☆

CANADIAN STUDIES

8 courses with a cumulative average of ≥ 65 , including CDNST 201, CDNST 211, and CDNST 212, one of HIST 253, HIST 254, and four electives chosen from a list of 18. A maximum of two of these can be chosen from any one subject field (ENGL, FR, HIST, INDG, PSCI).

Note that these are the only 3 Canadian Studies courses. This minor offers almost no freedom of choice of courses, and actively discourages you from exploring a particular area too much. Did you like the content of the English courses you took? Too bad, only two count.

☆☆☆☆

CATHOLIC STUDIES

8 courses with a cumulative average of ≥ 65 , including RS 110, RS 150, RS 151, one of (RS 348, RS 354), two of (RS 240, RS 245, RS 251, RS 283), and two from a list of 25 courses

This suffers from a similar lack of freedom to Canadian Studies. The list of electives is longer, and there's no restriction on taking courses in the same field, but you only pick 2 from the big list instead of 4.

★★☆☆

CHURCH MUSIC AND WORSHIP

8 courses with a cumulative average of ≥ 65 : CMW 363, CMW 364, one of (MUSIC 253, MUSIC 254, MUSIC 262), one of (RS 130, RS 235, RS 236), one of (HIST 235, HIST 348, HIST 379, RS 348), one of (RS 151, RS 152, RS 250, RS 257, RS 286), and two from a list of 9.

Another very restrictive minor, this one with more, smaller lists.

★★☆☆

CLASSICAL STUDIES

8 courses with a cumulative average of ≥ 65 in Classical Studies (CLAS), Greek (GRK), and Latin (LAT)

Freedom at last! This is almost too much freedom, though, with almost no guidance on what the core courses of the program are. CLAS courses have few prereqs, so it's up to you to determine which courses you need to cement your understanding of the area. Beyond that, you're also responsible for determining how many Greek and Latin courses to take.

★★★★

CULTURAL IDENTITIES

8 courses with a cumulative average of ≥ 65 including CI 100, CI 200, one course from a list of 20, three courses from a list of 38, and two courses from a language and culture subject (e.g. CHINA, DUTCH, LAT)

A good combination of both freedom and structure here. The biggest issue is that the lists of approved courses are difficult to parse, because they are long and drawn from many different subject areas.

★★★★

DIGITAL ARTS COMMUNICATION

8 courses with a cumulative average of ≥ 65 including at least four DAC courses, with up to four chosen from a list of 14 non-DAC courses

Fun fact: this minor is not possible for a math student, since DAC courses all require you to be an arts student to enrol.

★☆☆☆☆

EAST ASIAN STUDIES

8 courses with a cumulative average of ≥ 65 including EASIA 100R, four language courses from CHINA, JAPAN, KOREA that are not in the student's first language, and three courses from either EASIA or a list of 7 courses not in EASIA.

Requires a foundational course, that being EASIA 100R, and after that gives you a large amount of freedom. Like anthropology but with slightly less structure, however that's offset by the fact that courses are about either China, Japan, Korea, or East Asia in general.

★★★★★

ECONOMICS

8 courses with a cumulative average of ≥ 65 , including ECON 101, ECON 102, ECON 201, one of (ECON 206, ECON 207), and 4 additional ECON courses at the 200 level or above.

Provides a solid foundation that will complete many prereq requirements for later courses, while providing a good amount of choice once you've completed the foundation. Good design.

★★★★★

ENGLISH

8 courses with a cumulative average of ≥ 65 , including ENGL 200A, ENGL 200B, ENGL 251, and five additional English courses, at least one of which is at the 300 level or above and no more than two of which can be 100 level.

Again, provides a solid foundation while giving a good amount of choice once you've completed the foundation. The restriction on 100 level courses hurts, but only a little.

★★★★☆

TECHNICAL WRITING

8 courses with a cumulative average of ≥ 65 , including ENGL 210E, ENGL 210J, ENGL 292, ENGL 392A, two of (ENGL 210F, ENGL 210G, ENGL 210H, ENGL 210I), and two of (ENGL 335, ENGL 376R, ENGL 392B, ENGL 408B, ENGL 408C, ENGL 472).

One of the most restrictive minors, with only 90 possible combinations of courses. At least the requirements are easy to read.

★☆☆☆☆

Octopodes

profQUOTES 142.4**CS 146: ROB HACKMAN**

“ Remember build-list? You can use build-list with `sqr` and 25 and get a list with 0 squared, 1 squared, 2 squared, 3 squared, 4 squared, 5 squared, 6 squared, 7 squared, 8 squared, 9 squared, 10 squared, 11 squared, 12 squared, 13 squared, 14 squared, 15 squared, 16 squared, 17 squared, 18 squared, 19 squared, 20 squared, 21 squared, 22 squared, 23 squared, and 24 squared.

“ I should not have chosen 25.

“ That's the problem with teaching smart kids. They always want to jump ahead. What if I just want to tell a story?

“ C gives you just enough rope for you to hang yourself.

CS 146: BRAD LUSHMAN

“ **Student:** Does it matter if you put the star near the type or near the variable name?

Prof: There are a number of schools of thought on this topic.

“ Before we settle that definitively, let's muddy the waters a little bit first.

MUSIC 140: SIMON WOOD

“ Have any of you ever fired a nuclear missile?

“ That's the difference between research and plagiarism: in research you steal from a lot of different people, in plagiarism, you just steal from one.

PHIL 259: NICHOLAS RAY

“ **Student:** I don't like pizza.

Prof: Pizza's part of our species-being, what is wrong with you?

“ By the way, I like shitposting.

STAT 241: YINGLI QIN

“ [Projector does not turn on] It seems the projector is still in Reading Week mode.

DIVESTMENT: MY QUESTIONS FOR UNIVERSITY OF WATERLOO ASSOCIATE DIRECTOR, TREASURY TYLER WENDLAND

Tyler Wendland is the Associate Director, Treasury at the University of Waterloo.

I reached out to Wendland by email and asked him a few questions on the University's investments.

1. What counted as an “Energy” company for the purposes of compiling the Energy Sector exposure report?

“The industry sector an individual company is categorized into is determined by the stock exchange on which they trade (ie TSX, NYSE, NASDAQ, LSE, etc). Our investment managers apply the same breakdown in their reporting to the University. Companies that trade on multiple exchanges are typically listed in the same sector on each exchange.”

2. With the exception of a small investment in a uranium company, all the companies listed in the Energy Sector report are involved with oil and gas. In particular, there are no renewable energy companies listed in the report. Is this because renewable energy companies were not classified as Energy companies for the purposes of this report, or is it because the University holds no investments in renewable energy companies?

“While the University does not hold any “renewable energy” companies within those listed as Energy Sector companies, companies who develop or operate renewable energy projects/products can be listed in a range of sectors including energy, utilities, industrials, and technology. Because of this we cannot state for certain that the University does or does not hold investments in renewable energy companies.”

3. From my previous discussions with you and with [Associate University Secretary] Mike Grivicic, I was told that Fiera Capital is the only investment manager that was hired by the University since adopting an ESG policy. The Energy Sector exposure report you sent me shows that Fiera Capital is also the only investment manager that holds no Energy Sector investments. The University's ESG policy has been criticized by some as weak, since it does not lay out any specific concrete actions to be taken. Would you say that Fiera Capital's lack of investments in the Energy Sector shows that the current ESG policy is indeed effective?

“The evaluation criteria applied when Fiera was hired included an ESG weighting. Fiera does not specifically exclude energy companies in its investment portfolio but its decision to not currently own energy companies is based on a wide range of considerations, including their ESG analysis. It is possible that Fiera could own energy stocks in the future.”

4. Is Finance concerned that the discrepancy in Energy Sector investments between investment managers hired before and after adopting an ESG policy highlights that the old investment managers are not adequately considering ESG associated risks in investment decisions?

“I do not believe this is the case. ESG is a relatively new topic for the investment industry and there are no clear-cut guidelines on ESG reporting and/or best business practices. It is important to remember that ESG is not simply environmental, but also considers social and governance factors, so investments in the energy sector are evaluated based on more than just environmental impacts. Examples of other ESG considerations that investment managers may consider in evaluating investments are employment equity, fair wages, and safety protocols.

“[answer applicable to question 5 as well] All our legacy managers as well as our new managers are signatories to UN PRI and are committed to applying an ESG lens in their investment analysis. Each investment manager conducts their investment analysis differently. All investment managers must comply with each fund (pension, endowment, trust) investment guidelines which specifically require the implementation of ESG into the investment process. All investment managers' performance is reviewed quarterly. ”

5. After adopting the ESG policy, has the University reevaluated its relationships with any of the investment managers who were hired before adopting the ESG policy? Were the old investment managers subject to a review of how they consider ESG factors with the University concluding that they sufficiently address ESG factors in their investment decisions, or did they get to bypass the ESG policy due to being hired prior to its adoption?

“See previous answer.”

6. There is a noticeable difference between the percent of Energy Sector exposure between the pension, endowment, and special purpose trust. The endowment has 4.67% exposure to the energy sector, and the pension has only 2.09% exposure. What is the reason for this difference?

“The endowment has a significantly larger weight to Canadian Equities than the other portfolios and the energy sector is a much larger percentage of the TSX (Canadian stock market) than it is in other stock markets (US/London/World/etc).”

7. What would Finance say to students who are concerned that endowments, particularly faculty endowment funds that students contribute to, are being invested in a more volatile sector than pensions?

"The investment/asset weighting varies between the funds for a host of reasons. Pension funds are highly regulated and require a provision for adverse deviation which increases as the equity weightings increase. The trust fund has a shorter investment horizon than both the pension and endowment and there is more likely a need for earlier liquidity. Endowments are invested in perpetuity where the annual income needs to be sufficient to meet the spending obligations.

"I would also question the idea that the energy sector is a "more volatile sector" and would suggest that other business sectors are as, or more volatile (technology, industrial, health care)."

8. How does the University reconcile its investments in the fossil fuel industry with its climate change goals?

"The University's commitment to address climate change in its operations is similar to its investment approach. Both require multi-year/ongoing plans."

9. What is stopping the University from immediately requesting all of its investment managers to cease investing the University's money in fossil fuels?

"The University's equity investments are generally in pooled funds (rather than segregated funds). Those pooled funds include many other investors. Those funds are not designed to have inclusions or exclusions specific to the entities investing in them. Instead, the investments are common across all the investors in the pooled fund. The University does discuss ESG issues with the managers of those pooled funds so that we understand their investment approach and determine whether they are consistently applying their stated approach."

—

I then replied back with a few followup questions.

Question 6 followup: Why does the endowment have "a significantly larger weight to Canadian Equities than the other portfolios"?

"There are a variety of different reasons for this, but the main points would be that; 1) different investment mandates have different stated risk tolerances and objectives and the investment allocations are put together to reflect these variables, and 2) the size of the investment mandate impacts the amount of asset types and classes that can be utilized."

Question 8 followup: As addressing climate change is an ongoing approach, is fossil fuel divestment currently a part of or being considered to be made a part of the ongoing approach? Could you see fossil fuel divestment becoming a part of the University's climate change approach in the future, and if so, what would it take to make that happen?

"Investment oversight is provided by the Finance & Investment Committee of the Board. The information that I have relates to the primary operational responsible investment objectives for the University's investment mandates that have been established at the current time; these include becoming a signatory to the UN PRI, ongoing dialogue with investment managers on Responsible Investment topics and their ESG approaches, and developing and implementing reporting on responsible investment activity."

Question 9 followup: Previously, I have heard fiduciary responsibility cited as a reason by some organizations as to why they cannot divest from fossil fuels. I have also heard this claim be contested by other organizations and people. Your answer does not mention fiduciary responsibility as a reason that Waterloo cannot divest from fossil fuels. Does the University of Waterloo believe that current fiduciary responsibility laws prevent divestment from fossil fuels?

"I can refer you to the Responsible Investment Working Group's comments on fiduciary duty, available on page 175 of the June 2018 Board materials package, available here: https://uwaterloo.ca/secretariat/sites/ca.secretariat/files/uploads/files/20180605oagbog_package.pdf Ongoing consideration will need to be made of fiduciary duty requirements for specific investment policies and decisions as they are considered; this would include further consideration of fiduciary duty with respect to any consideration of divestment of fossil fuel investments."

Vincent Macri

ISSN 0705-0410

UW'S BASTION OF ERUDITE THOUGHT SINCE 1973

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gridWORD: HELL EDITION

gridCOMMENT #1.2 * 2

Welcome back from Reading Week! You know, the week where you catch up on all your work. Oh, you didn't do anything? I guess that's fine too.

I do think overall every term should have one of these—it's a great gas pressure valve that lets off some much-needed steam and helps with mental health massively. But, there is also an argument to be had regardless on year-wide scheduling shenanigans, and I feel I am not an expert on that.

Anyways, I have received 6 papers, 2 of which were a **haltingPROBLEM** solution...? Name/Moniker followed by their answer to last week's **gridQUESTION**, "What is the best way to prepare for war against a **gridWORD**?",

- Big Bean Burrito: "Make friends with the geese"
- Anne, Kathy, Martha, Leanne: "are you guys trying to drive away your entie female audience? ;-;"
- Link: "The pen is mightier than the sword, so I would assemble a great army of multi-coloured pens."
- Exile: "Prepare by inhaling a dictionary"
- Psykarp: "The best way to prepare for war against a **gridWORD** is to gain the **haltingPROBLEM** as an ally." (Honorable mention, they submitted their **haltingPROBLEM** instead)

Clearly, inhaling a dictionary shows dominance and jumps your vocabulary by 9001%, so it wins, congratulations! Exile, go over to the **mathNEWS** office at MC 3030 for your prize.

For some other news: I will not be here in Spring 2020. So I suppose if you will be here in Spring 2020 and want to learn how this lonely job works, you can drop by during i5 or i6's production night or some other time (that we can prearrange via you emailing mathnews@gmail.com and I can respond to you on a separate follow-up email). Or if no one wants to do it, then we can shove this seat to some poor editor. I mean, they'll probably do a better job the me anyway, right?

To first-timers here at **mathNEWS**: the **gridWORD** is a feature column of **mathNEWS** wherein a tiny and edible crossword can be solved at your leisure. You may choose to submit it either via the **blackBOX** mounted next to the Math C&D's neon sign, or electronically to mathnews@gmail.com. The deadline for v142i4 is March 9, at 18:00. Please include your name, optionally a moniker, and a **gridWORD** with your solution attempt on it. Also optionally your answer to this issue's **gridQUESTION**, "What is your best answer to a question that doesn't exist?"

This **gridWORD** I concocted is...kind of unfair. I apologize in advance.

Happy solving!

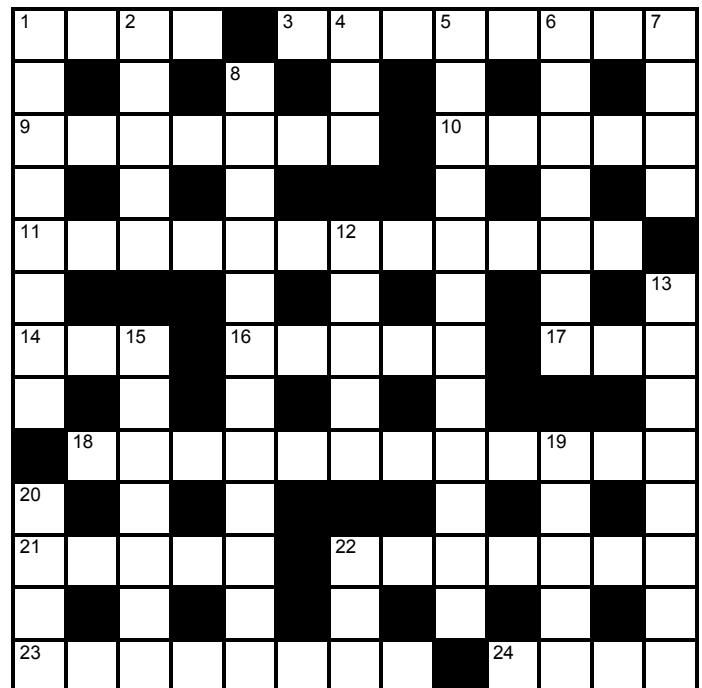
Solar Flare

ACROSS

1. One of 6 UWaterloo faculties (4)
3. CS 136's bane (8)
9. Satirical ship skits (7)
10. Implying sans the little devil (5)
11. A cause of simple harmonic motion (12)
14. One of 6 UWaterloo faculties (abbr.) (3)
16. Seafoal manure (5)
17. One of 6 UWaterloo faculties (abbr.) (Also recently lost a war against math..?) (3)
18. Mao: Rules violation query (Non-Mao players: Procedural question) (5,2,5)
21. Throw out of a house (5)
22. O(infinity) (7)
23. Not easily guided from (8)
24. One of 6 UWaterloo faculties (4)

DOWN

1. Wrong designation (8)
2. Ancient Greek/Roman garment (5)
4. One of 6 UWaterloo faculties (abbr.) (3)
5. Psychedelic / What this **gridWORD** isn't (12)
6. One of 6 UWaterloo faculties (7)
7. Wearable scrambled catsharks (4)
8. Meat and veggies concoction (8,4)
12. Something to remember in Texas (5)
13. Despite its name, may not actually contain eggs (3,5)
15. One who plays the viola (7)
19. Gulf currency (5)
20. Male lover (4)
22. You hear here (3)



lookAHEAD

SUN MARCH 1

Application to graduate due

MON MARCH 2

Main round co-op rankings available at 12pm

TUE MARCH 3

Co-op rankings due at 2pm

WED MARCH 4

Co-op matches available by EOD

THU MARCH 5

Continuous round job postings start

FRI MARCH 6

SAT MARCH 7

SUN MARCH 8

International Women's Day

MON MARCH 9

mathNEWS 142.5 production night

TUE MARCH 10

Continuous round interviews start

WED MARCH 11

THU MARCH 12

mathNEWS 142.5 released Friday the 13th 🍀

FRI MARCH 13

SAT MARCH 14

STILL CASH ONLY, BUT NOW FOR A FINITE AMOUNT OF TIME

We've now transferred completely to a new system for handling sales and rentals in the MathSoc Office (MC 3038). Drop in for some cheaply priced calculators, stationery, or clothing, processed on a state of the art point of sale! How exciting.

Andrew Yates
MathSoc VPO, Winter 2020



APPLY TODAY AT WUSA.CA/FUNDING

LAST WEEK'S gridSOLUTION

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

LAST WEEK'S halting SOLUTION

