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The Quiet Gift of Mentorship: A Personal Journey Toward Mathematics

Cover Article

Zohreh Shahbazi (University of Toronto Scarborough)

NomadFor some time, I have been reflecting consciously on my own path: how I came to mathematics, how I grew within it, and how the people and experiences around me quietly shaped the way I think, teach, and understand the world. My relationship with mathematics began early, sparked by success in competitions and nurtured by curiosity.

I pursued Pure Mathematics at Sharif University in Iran as part of the first cohort of a newly established program. The curriculum was rich and rigorous, yet it did not fully satisfy my deeper questions. What is it about mathematics that draws me in? Why does thinking, learning, and discovering bring me such joy? These questions stayed with me when I later continued my studies at the University of Toronto, all while raising twins and navigating the inevitable ups and downs of graduate school. The fear of not understanding, of being lost in a concept's darkness, was painful. But, that pain became a powerful motivator. It pushed me to seek clarity, to find pathways through confusion, and ultimately shaped my approach as an educator. When I became a professor, my teaching philosophy centred on guiding students through that same journey: embracing uncertainty, persisting through difficulty, and discovering the beauty that emerges from understanding.

In recent years, my reflections have taken a new direction: Over the past couple of years, I have been holding weekly online sessions with my father to read and discuss Rumi's poetry. Together we explored themes of morality, spirituality, and the human condition.
These conversations awakened memories I had not revisited for decades, such as the moment in grade one when my father gifted me a copy of "Good Stories for Good Kids: Book One" by Mehdi Azar Yazdi, a collection that retells stories from Rumi's Masnavi in a language accessible to children. The book had no colourful illustrations, yet its stories opened a world of wonder. I did not know then that those stories would accompany me throughout my life, resurfacing whenever I encountered Rumi's work, whether through commentaries by scholars like Allameh Jafari or through my recent sessions with my father.

One story we discussed recently tells of a man from the desert, who wishes to meet the Khalifa (Caliph) and explain how difficult his life is. Wanting to bring a gift, he carries with him the most precious thing he owns: a small bowl of water from the desert, where water is scarce and treasured. When the man reaches his destination, the Khalifa accepts the humble gift with kindness. Then, in an act of generosity, he orders that the same bowl be filled with gold and jewels. Before sending him home, the Khalifa instructs his guards to take the man to the great river, Dejleh, the Tigris, since that is a shorter path easing his journey back home.

When the man sees the vast, flowing water, he becomes deeply ashamed of his small offering. He wonders how the Khalifa could accept such a modest gift and yet return so much treasure. The story ends with a reminder that the entire world is like a jug overflowing with understanding, knowledge, kindness, and beauty, just a drop from the endless goodness and power of the divine creator. In Rumi's telling, creation itself is the bursting forth of this hidden treasure. And if one knocks on the door of knowledge sincerely, the creator grants the feather of thought, lifting the seeker like a shahbaz, the royal falcon, into higher understanding. (The Masnavi of Rumi, Book One, Story IX: The Nomad and His Wife)
This story resonated with me, because it mirrors how I have come to understand my father's influence on my own thirst for learning. My father is a retired high school mathematics teacher. His small library of math books shaped my earliest encounters with the subject. Concepts such as the name and its referent, limits, and integration first appeared on his bookshelf, inviting me into a world of symbols and ideas. Although he never encouraged me to pursue mathematics professionally, and at times even discouraged it by warning that the path may offer little comfort or financial reward, what he instilled in me was far more powerful. His values, his commitment to truth and justice, and his love of learning guided me more strongly than his cautionary words.

Only later, through my own teaching, did I realize how skillfully he had prepared me for my journey. He trained my mind with subtle techniques, building confidence without ever placing himself at the centre. Like the Khalifa in Rumi's story, he accepted my small bowl of water, my early curiosity, and quietly returned a river. He stood behind my shadow, yet his influence shaped every step of my path.

And his impact extends far beyond me. Over the years, I have witnessed countless moments when strangers approached him in hospitals, banks, and museums, recognizing him as their former teacher. They speak with warmth and gratitude, sharing how this humble, moral, humanity-loving educator changed their lives. Hearing their stories always reminds me of the quiet ways he guided me as well. During my undergraduate years, he sent me letters in his elegant handwriting, each one carrying a blend of moral guidance and gentle encouragement. In them he urged me to respect others, to speak up for the truth, and to meet the challenges of independence with courage. Those letters were small lanterns in a difficult time, illuminating the strength he hoped to cultivate in me. Together, these memories and encounters reveal a legacy built not through awards but through quiet, consistent dedication to students and to the transformative power of education.
As I continue to reflect on my own path, I see more clearly how mathematics and mentorship are deeply intertwined. My journey has been shaped by curiosity, persistence, and the profound influence of a teacher who never sought recognition. In many ways, the values he embodied, humility, the pursuit of truth, and a deep respect for learning, continue to guide my work within the mathematical community today. In my view, the most effective education draws strength from both the wisdom of the past and the creativity of the future. When timeless insights, such as those found in Rumi's teachings, are combined with new means such as artificial intelligence, they can enrich learning while keeping its human purpose at the centre.

Society's Problem

Editorial

Robert Dawson *Editor, Notes*

This weekend, there were demonstrations across Nova Scotia against the planned construction of a data center near Port Hawkesbury. The originally-announced business plans of the company involved, EverWind, had involved the construction of wind farms, the electricity from which would produce "green" ammonia for export to Europe. Many Nova Scotians felt that producing energy for export while the provincial grid still relied on significant use of hydrocarbon fuels was a bad idea, though it can be argued that since Nova Scotia and Europe share an atmosphere, the important thing is not where, but by how much, global carbon emissions are reduced. Everwind's sudden announcement that they intended to focus on providing facilities for enormous banks of foreign-owned computers was not popular, especially if, as reported, the data center is to be constructed before the generators are in place, taking its power from the grid in the meantime. It's not clear what this will mean for consumer electricity prices, but a similar project in Alberta, to be powered by a methane-burning plant that will likewise not be built until well after the computers are running, is forecast by the Pembina Institute to boost that province's domestic power bills significantly. And, of course, we do have calm days here in Nova Scotia, though you wouldn't always think so. On those days the data center would buy power from the grid or burn diesel.

Nova Scotia is not the only place waking up to find data centers trying to move in, or the only one where they are not popular. It was recently reported that anti-data-center sentiment was one likely reason why the US midterm elections had gone even more strongly against the Republicans than had been anticipated. This is particularly true where water is in short supply (at least the Nova Scotian plant, while it will use a lot of cooling water, would use far less than can be safely taken from the local lake under normal conditions) but there do not seem to be very many places where people want a data center in town.

It's not just the environmental impact. People frequently tolerate strip mines, bitumen extraction, clearcuts, pulp mills, oil refineries, cement plants, and other dirty, power-hungry, industries, because "it's the smell of money." Many a business park dwarfs the hundreds of hectares of a data center. The new kid on the block is unpopular, I suspect, because of a widespread opinion that much of what it's doing is not, in the balance, beneficial. One the one side we hear about the lost jobs, the security leaks threatening the internet, the revoked literary prizes, and the harassing deepfakes that make even a school yearbook picture a possible source of shame and embarrassment. On the other side…what? More social media memes? Easier application letters? Higher share prices for the tech companies that are still plowing money into their data centers far faster than new value is emerging?

The mathematical community has its own problems with the sudden rise of generative AI. But the question of if, and how, AI can be made useful to society is everybody's problem, not just ours. Different groups have different problems, though also, sometimes, new applications that give some hope for the future. Are we, overall, going in the right direction? It would not be reasonable to expect the interests of those building the data centers to coincide with the professional interests of the mathematical community, but do they coincide with those of society at large? Right now it's not clear that they do, nor how this can be changed.

Progress in Logic and Mathematics

CSHPM Notes

Nicolas Fillion (Simon Fraser University)

CSHPM Notes brings scholarly work on the history and philosophy of mathematics to the broader mathematics community. Authors are members of the Canadian Society for History and Philosophy of Mathematics (CSHPM). Comments and suggestions are welcome; they may be directed to the column's editors:
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As they develop, grow, and mature, sciences change quite significantly. Moreover, the changes are not only cosmetic, but very much substantive. It would be hard for anyone to deny either of these propositions. Over the past few millennia (or even, in some cases, decades), we have witnessed the emergence of completely new methods, the overthrow of deeply entrenched theories that once seemed to be as unshakable as can be, and their replacement by new, once unimaginable, alternatives. Hence there is no question that science constantly re-builds itself, so to speak. Kuhn famously argued in [8; Figure 1] that science evolves by going through phases of normal science and revolutionary science. In normal science, the progress is primarily of a cumulative nature following which more "small" problems get solved. The model of progress in this phase is that more and more questions become settled, and more and more confirmed truths get added to the scientific inventory. However, increasingly-stubborn problems that resist the best solution attempts lead scientific communities into a period of crisis, which eventually resolves itself into a revolution. The revolution is a radical break with the past that overthrows and replaces not only theories and methods, but also in some cases standards, inquiry values, ontologies, and entire conceptual frameworks (referred to collectively as 'paradigms'). The progress associated with revolutions is not cumulative; rather, it has destructive elements that require rejecting propositions previously thought to be true. Kuhn's thesis has led to much debate. Some historians of science have argued that his historiography is misleading, sometimes inaccurate. Some philosophers have argued that the term 'paradigm' is too hopelessly confused to be of any use. And many sciencephiles from all academic necks of the woods have urged that some of Kuhn's most strikingly relativist views (e.g., his claim that adopting a new physical theory is akin to a religious conversion) fail to capture the rationality inherent to the march of science. But the fact remains: although there are important nuances and disagreements about how science changes over time, and to what extent, the existence of substantive changes is beyond doubt. It is also hard to dispute that some aspects of scientific change are of the non-cumulative type Kuhn had in mind.

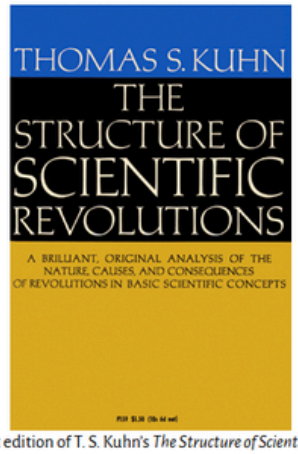


Figure 1. First edition of T. S. Kuhn's *The Structure of Scientific Revolutions* (University of Chicago Press, 1962). *Wikipedia.*

Mathematics certainly undergoes substantive change as well; I would be shocked if any reader of the CMS Notes disagreed. Once again, the debate is more concerned with how mathematics changes over time, and to what extent. There is undeniably a cumulative dimension to the growth of mathematics: more problems get solved, more propositions are proven, and more powerful methods of analysis are developed. However, compared to the enormous literature on scientific change and on paradigms in history and philosophy of science, there is surprisingly little in history and philosophy of mathematics. One place to begin is by asking whether there are also non-cumulative aspects of the growth of mathematics. To my knowledge, the first study to consider the possibility is Lakatos' Proofs and Refutations [9; Figure 3]. By examining the history of concepts such as "polyhedron" and "continuity", he showed that there sometimes are transformations that reconceptualize parts of mathematics in a deep way that doesn't quite fit the cumulative view of progress. Do such profound transformations rise to the status of Kuhnian revolutions? A rare source that addresses this issue is a collection edited by Gillies [5]. Some authors deny that there are revolutions in mathematics, while others support the claim with examples such as non-Euclidean geometry, irrational numbers, the calculus of infinitesimals, Cantorian set theory's analysis of infinity, and Hilbert's formalist philosophy. The debate revolves around what is considered a revolution. Gillies considers two "models", i.e., the Franco-British revolutions and the Russian revolution. A few years ago, I suggested in [3] that neither captures change in mathematics, but that Quebec's quiet revolution in the 1960s—one in which no official political regime was overthrown or experienced lost importance, and yet it yielded a thorough renegotiation of how things were to function within given institutions, in order to make society work better for people and get more from those institutions—is a plausible model of some profound transformations in the history of mathematics. But whatever one ultimately thinks about this question, recognizing the existence of non-cumulative change in mathematics raises many puzzling questions about what mathematics is, as a branch of knowledge.

One difficulty is that mathematics is so profoundly entangled with logic and the axiomatic method. Since Aristotle articulated the guiding principles of the axiomatic method in the Posterior Analytics (Figure 2), which was shortly after adapted and implemented by Euclid in The Elements, it has been a constitutive element in what it is to practice mathematics at its highest level. Following the tradition, axiomatic science (including mathematics as the case par excellence) is structured so that we start from self-evident truths (or, at least, propositions known to be true) and deduce other propositions whose truth will then come to be known owing to the fact that deductions are chains of reasonings each step of which is known to be valid. And ultimately, validity is a matter handled by logic. From this perspective, progress is associated with "more knowledge", which is accomplished by proving more propositions from given axioms and by applying the method to more axiom systems (although one would likely grant that not all propositions or axiom systems weigh the same, progress wise).

Where can non-cumulative progress—the progress that requires overthrowing something—fit within this traditional perspective? One possibility is that something that was thought to be proved was not actually proved, i.e., that we were duped by an incorrect proof. That would prima facie require one of two things: (1) a proposition accepted as self-evident turned out to be false or (2) an inference thought to be valid turned out to be invalid. There are of course many famous cases of both in the history of mathematics. But both ultimately boiled down to us making mistakes. Now, correcting mistakes is hardly the sort of deep transformation that we have considered so far. If there is to be any such thing in mathematics, we must look elsewhere.

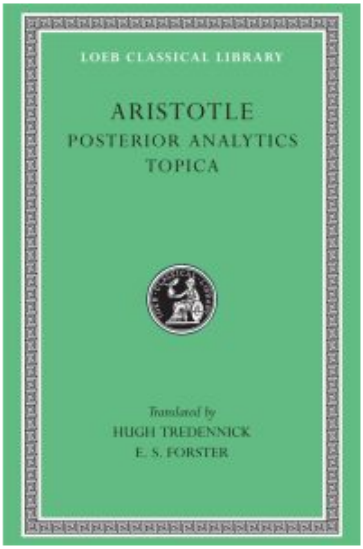


Figure 2. Loeb edition of Aristotle's *Posterior Analytics* (Harvard University Press, 1960). Amazon.

The natural place to look for deep transformations in mathematics is by considering that the axiomatic method itself has transformed. Firstly, we may attempt to trace substantive rethinking of the notion of axiom. Indeed, historically, this happened when the notion of axiom separated from the notion of self-evident truth. This parting of ways was deeply entangled with the development of non-Euclidean geometry. An interesting locus where this transformation found its expression is in the Frege-Hilbert controversy on the foundations of geometry that followed the publication of Hilbert's 1899 Grundlagen der Geometrie (the letters can be found in [4]). Interestingly, this exchange reveals that much of Frege's ingenuity and logical innovations were deployed to defend the old Euclidean perspective on axiomatic systems that would be overthrown, and that he very much struggled to even understand the new approach to axiomatic science advocated by Hilbert, calling it "pseudo-science". This transformation was key to developing the structuralist philosophy of mathematics that is now very much associated with modern, post-19th-century mathematics [10].

This was indeed a profound transformation that, at least plausibly, has a revolutionary character, or at the very least accounts for some form of non-cumulative progress in mathematics—as axiological requirements were overthrown. Yet, such transformations of the axiomatic method don't exactly happen very often; in fact, there seems to be only one occurrence of it in the history of mathematics, which would imply that there has been only one episode of non-cumulative progress in the history of mathematics. There must be more to it.

Looking back at Lakatos' observation leads to yet another potential source of deep transformation that can be interpreted along this line. One reason to reject the requirement of starting from self-evidently true axioms is that axioms are propositions relating concepts with each other, and that concepts usually have a degree of malleability that prevents one from conclusively declaring a proposition self-evidently true. Lakatos' history of the concept of polyhedron is a case in point; it starts from what appears to be a satisfactory list of necessary and sufficient conditions to define the concept of polyhedron, i.e., a solid body bounded by polygonal faces, but then difficulties arise as the "intuitively clear" geometrical shape slowly morphed into the topological notion of being homeomorphic to a sphere. Given the open-texture of concepts and the way they transform as a science develops, we must conclude that "it has proved not to be so intuitively clear what is intuitively clear in mathematics" [6]. Intuition-driven conceptual analysis had to be abandoned—not for being useless but for being too limited—as the foundational basis for mathematics.



Figure 3. Imre Lakatos in the 1960s. *Wikipedia*.

There is (at least!) one more tantalizing place to look for deep transformations in mathematics: in deep transformations in logic, which refers back to (2) above. Given that the axiomatic method largely boils down to how we think about the axioms and to how we think about logically valid inference, there would ipso facto be deep transformations in mathematics if there were such deep transformations in logic.

Are there deep transformations, potentially revolutions, in logic? Answering the question requires that we consider a history that spans nearly 2400 years, from the time when Aristotle wrote the Topics and The Prior Analytics (and the rest of the Organon) to our days. The same man (Figure 4) who presumptuously asserted that the axioms of Euclidean geometry were necessary truths just a few years before Gauss, Bolyai, and Lobatchevsky opened the new field of non-Euclidean geometry also had rather uncompromising things to say about the possibility of change in logic:

That from the earliest times logic has traveled this secure course can be seen from the fact that since the time of Aristotle it has not had to go a single step backwards, unless we count the abolition of a few dispensable subtleties or the more distinct determination of its presentation, which improvements belong more to the elegance than to the security of that science. What is further remarkable about logic is that until now it has also been unable to take a single step forward, and therefore seems to all appearance to be finished and complete [7, Bviii, p. 106, emphasis added].

Although few have the temerity to make stunningly false claims with this level of assurance and determination, Kant's opinion that logic essentially doesn't change is in my experience fairly widespread.And yet, already by Kant's time, logic had made significant changes since the time of Aristotle. One source of misunderstanding is that the phrase 'Aristotelian logic' is used to refer both to a particular doctrine (the theory of syllogism as laid out in Prior Analytics A, 1-2 and 4-7) and to a centuries-long tradition that persists to our day. For example, readers familiar with Aristotelian logic may have learned the so-called theory of reduction of syllogisms, where syllogistic moods have names such as Barbara, Celarent, Baroco, Bocardo, Festino, etc., whose consonants encode proof steps to show their validity. This, however, is not how logic is thought of in Prior Analytics. Although there are significant debates about how best to interpret that work, the best way to think of how Aristotle himself developed logic in analogy to modern treatments would be to say that his system is a natural deduction system [2; 12]. On the other hand, the theory of reduction mentioned above is definitely not a natural deduction system. It was developed in the high medieval period (its origins are rather muddled), and it is best thought of as a sequent calculus. Now, perhaps Kant thought that the medieval invention of sequent calculus is a "dispensable subtlety", a mere cosmetic change in logic with no substantive value, but that says more about Kant than about logic. In fact, there is an abundance of major developments in logic in the medieval period, so much so that Bocheński referred to the period as one of the three golden ages in logic (alongside ancient Greek logic and the 20th century). For example, yet another entirely different way of thinking about logic was developed in the late medieval period, i.e., the so-called doctrine of distribution of terms and the doctrine of supposition. This enabled logicians of the time to develop Aristotelian logic in new directions. For example, from the time of Ockham and Buridan, the analysis of inferences involving oblique terms became a focus. Buridan outlined a way of showing the validity of this argument:

Every donkey of a man runs.

Some man is a master of a school.

Therefore, some donkey of a master of a school runs.

It may not look like much to a modern reader, but it introduces arguments involving more than three terms, and it involves a form of relational logic with nested terms (e.g., Christ is God. Mary is the mother of Christ. So, Mary is the mother of God) that goes far beyond Aristotle's logic. There are many other major developments in that period, e.g., some elements of modal semantics that go beyond Aristotle's modal logic. It is clear that Kant wasn't particularly well-versed in the history of the discipline about which he was claiming that it hasn't and cannot change. It turns out to be easier for one to argue that logic doesn't undergo substantive change if one doesn't know the history of logic.



Figure 4. Immanuel Kant as painted by Johann Gottlieb Becker in 1768. *Wikipedia*.

Others argue at the other end of the spectrum, that logic has changed so much since the time of Aristotle that it's essentially a new thing altogether. For example, here's Quine:

Mathematical logic differs from the traditional formal logic so markedly in method, and so far surpasses it in power and subtlety, as to be generally and not unjustifiably regarded as a new science [11].

If we take Quine completely literally, he's not saying something along the lines that there was a revolution within logic; rather, there was the birth of a new thing also called 'logic' that is the better sibling of the old one. Still, it's clear from the rest of the Introduction that Quine still considered the old and the new logic to be in continuity with each other; so, Quine is committed to the existence of deep transformations in logic, and it may not unjustifiably be interpreted as a revolution

That would seem to be yet another potential source of deep, substantive change in mathematics, that may not be cumulative in nature. In the process, some arguments previously accepted as valid were overthrown, e.g., "All A are B, therefore Some A are B" and all other arguments involving "existential commitment" of universal conditional premises. The reasons behind this change run deep and there is no way to do them justice here. Instead, let us conclude by asking whether this potential source of substantive change is distinct from the first two, and whether those two are actually distinct themselves. There were indeed very important transformations in the axiomatic method, in the analysis of mathematical concepts, and in logical methodology—and importantly they all occurred roughly at the same time (late 19th and early 20th century). Although the three are certainly to some extent distinct, they form something like an intellectual version of a small forest connected by a mycorrhizal network. Is this analogy any good? In order to find out, you are invited to get into the study of the history of logic as it intersects with the history of mathematics, the philosophy of mathematics, and mathematical practice itself. There perhaps used to be more pressing things to do, but now AI will take care of them!

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Commercial Mathematics

Education Notes

Egan J Chernoff (University of Saskatchewan)
Education Notes Contributing Editor

I love commercials. Always have. By "commercial" I am referring to videos, short in length (e.g., 30 seconds), that are made and paid for by a company looking to promote something (e.g., a product, service or idea) by airing them during a break in scheduled television programming. Commercials, also known as ads, breaks or spots, often get lumped under the term television advertisement, which helps to demarcate them from those annoying videos you can't wait to skip before being allowed to watch a YouTube video.

At the moment, my favourite commercials are part of an advertising campaign by the Progressive Corporation, which is an insurance company based in Mayfield, Ohio, USA. In them, Life Coach Dr. Rick tries to help/save new homeowners from becoming their parents. In one commercial, for example, Dr. Rick is called to try and help a proud new homeowner that is, yup, cleaning his trash cans. In other commercials, Dr. Rick takes new homeowners to different scenarios (e.g., the airport, a Big Box store or waiting room) and teaches them not to use the speaker phone, not to stare at a person with blue hair and to try and keep to themselves while waiting in a room or standing in a line. If you're wondering how insurance is added to the mix, Progressive notes that while they can't help you from becoming your parent(s) they can help you save on home and auto insurance. Silly, sure, but Progressive definitely has my attention. To date, Dr. Rick appears in 39 commercials for Progressive and, to me, everyone of them is excellent.

Concurrently, my least favourite commercials involve mathematics. Take Little Caesars, the pizza chain, and their Three-Meat Treat advertisement where NFL football player Amon-Ra St. Brown, while standing in front of a portable black board full of what looks like pizza-based mathematics, says to the camera "Meat plus meat plus meat". The announcer in the commercial then replies with "Wow, Professor Amon-Ra, you're a great mathematician". Amon-Ra clarifies, however, he's "more like [a] Meatmatician", which, I'm assuming, is a mathematician that works for Little Caesars' in the field of three-meat treats, in general, and bacon, Italian sausage and pepperoni, in specific. For the record, Little Caesars, historically, has had some amazing commercials, but, for me, this one just misses the mark.

In an entirely different commercial, but in a very similar theme, “Endless Shrimp” recently returned to Red Lobster, the chain of seafood restaurants, but only for a limited time. To help advertise their Endless Shrimp promotion, Red Lobster aired a television commercial, that asks, “What’s more endless than infinity?”. On the face of it, that’s an ok question. Soon, however, a non-breaded shrimp (on the left) and a breaded shrimp (on the right) overlap the outer curved edges of a glowing infinity symbol dominating the majority of the television screen, and the commercial then answers its own question: “Shrimpfinity”. No time for productive struggle in a 30 second television commercial, I guess. Shrimpfinity, sure, is a decent portmanteau, but, and I’m not sure why, I was expecting a bit more in a commercial from an international sea food company and restaurant chain. Red Lobster, like Little Caesars, is missing the mark, for me, in terms of commercial mathematics.

The least favourite of all my least favourite commercials involving mathematics, by far, is the recent “Parent Math” campaign for the 2027 Chrysler Pacifica. For those of you that haven’t seen the commercial, it begins with overlaying a number of equations, in white ink, over a shot of two parents driving the very popular vehicle. The announcer then proceeds to describe some examples of Parent Math (e.g., how packing light ironically equates to many suitcases, using nonstandard units of measurement regarding space, and how the shortest distance between two points is not a straight line) while different features of the van are presented. The commercial ends by declaring that everything “adds up perfectly” thanks to Parent Math, which cues another set of equations, in white ink, that float in, around and over a bird’s eye view of the van. Now, if you’re thinking that my distaste for this commercial stems from the various equations that float around at the beginning and end of the commercial, that’s a good guess. However, there’s an entirely different reason for my vociferous view regarding this commercial.

The use of “Parent Math” in the 2027 Chrysler Pacifica campaign, I contend, is a simulacrum of “Girl Math”. For the uninitiated, the origins of Girl Math can be traced to an FM radio show over in Auckland, New Zealand. Specifically, ZM Radio’s Fletch, Vaughan & Hayley, the breakfast show, which runs from 6:00 am to 10:00 am weekdays. On the show, circa the summer of 2023, Hayley Sproull (and two then producers, Shannon and Carolyn [sp?]) introduced the notion of Girl Math when explaining that, yes, they were getting their hair done, but they were, basically, getting it done for free; and, a similar reasoning was employed when warranting the purchase of an expensive hand bag. The humour of the justifications and absurdity of the outcome was apparent and Girl Math, right there, right then, became a thing.

The day after, they discussed soft launching Girl Math as a bit on the show (e.g., having a title, dedicated time segment, musical introduction, etc.) where individuals would text and/or call into the show describing purchases callers had made or were about to make, which were then cleverly and entertainingly justified and rationalized with, what I'll call, a certain financial logic. Four hundred dollar hair extensions for a wedding, on the one hand, were justified relative to the cost of needing to get remarried for better photos because of not getting said hair extensions the first time and, on the other hand, how little the extensions were going to cost when considered per inch. By way of another example, the cost of attending all four nights of Taylor Swift's Eras Tour was softened through a discussion of four-for-one flights, watching free video concerts, Vienna, Austria and how being at the concert is, well, priceless. Soon, the bit took off and, thanks to the internet, Girl Math began to spread all over the world.

I think that Girl Math resonated, for me, because I realized that I, myself, practice a version of Girl Math during my conference travels. Thanks to my Professional and Research Funds, I'm able to travel to a few conferences per year. No longer looking to procure external funding, however, I need to stretch my funds to try and attend more, as opposed to less, conferences year over year and with limited funding. To achieve this goal, I employ what I now call, "Per Diem Math". Turns out, many of the central tenets of Girl Math are also central tenets of Per Diem Math.

I should mention, here, that Girl Math really exploded worldwide when snippets of Girl Math segments were posted on ZM Radio's social media platforms (e.g., TikTok, etc.). Soon, examples of Girl Math permeated social media. In doing so, certain rules, examples and themes were documented and categorized. According to Girl Math, paying for something with cash means you're getting it for free, for example. Sure, sure, paying for something with physical cash isn't necessarily free, but feels free because one's bank account does not dip with the purchase in real time because the removal of the cash has already taken place prior to the purchase. The money has, essentially, already been spent.

I get it. In terms of Per Diem Math, by way of a parallel, I am allocated, during conference travel, to $10, $18 and $23 each day for, respectively, breakfast, lunch and dinner. As I am apt to do, I head to the bank before I travel for my conference at take out $51 ($10 + $18 + $23) times however many days I am travelling because I will be reimbursed that amount after the conference. In this manner, I have a "free" $10 every morning for my breakfast. Taking things a step further, if I decide to exercise some intermittent fasting during the morning or if I've packed a few protein bars to go with some crappy, in-room hotel coffee, then I can usually make it to the first nutrition break of the day for the conference, which means, in essence, that I have saved spending a free $10, which, it can be argued, means that I've made $10. Over a five day conference, I've made $50. Usually, however, said $50 starts to burn a hole in my pocket and instead of coming home with extra Per Diem money, the $50 that I spend buying beer for my colleagues at the pub or a nice bottle of wine for the room with friends is deemed "free", which makes it taste all the better. Cash meaning free is not the only central tenet shared between Girl and Per Diem Math.

Cost per wear or cost per use is central to Girl Math. Sure, an item of clothing (or whatever you are buying) can be expensive. If you consider the cost per use, though, it rationalizes a very expensive item, like a thousand dollar coat that gets worn regularly over a five or ten year period, and drops the cost to a reasonable cost per use for the item. Stated in Per Diem Math parlance, staying in accommodations that are close to or where it is easy to get to the conference venue, say either within walking distance or with a simple ride on public transit, helps stretch Professional and Research Funds. Sure, I could take a taxi or a rideshare to and from the conference (and to and from the airport) and, yes, that money would be reimbursed after the conference. However, every time that I am able to walk or take public transit to and from the conference venue or to and from the airport then I am, in essence, saving money for my next conference where, sure, I'll still have to walk or take public transit, but the alternative would be not even attending that next conference. Cost per use, then, applies to not only goods (e.g., clothing) but services (e.g., transit), as well.

Part of the joy of Girl Math is the creativity, the logic, the humour, and the absurdity in rationalizing particular purchases or spending behaviours. When the central tenets – whether it be items on sale equating to profit (because the money you've saved can be elsewhere spent), advanced payments or refunds equating to free money (because that money was already spent or spent money has come back), or spending a bit more money to get over the free shipping threshold (I mean, that just makes sense) — are couched within creative and relatable examples, Girl Math is firing on all cylinders. However, as is usually the case these days, the very Internet that helped propagate Girl Math all over the world was also used to tell said world that Girl Math was, actually, a new blight on society.

Turns out, the lighthearted, creative financial logic behind Girl Math was soon labelled a scourge. Who knew?! Not me. See, while I was having fun and attempting to relate Per Diem Math to Girl Math more and more, the rest of the world turned on Girl Math and it started to encounter widespread criticism. Sure, while some people in finance were explaining how certain central tenets were fiscally sound and akin, for example, to amortization, they were drowned out by other voices that called Girl Math a disaster, a problem, and something that could ruin one's life. To be clear, I fully agree that harmful debt is harmful and reinforcing stereotypes can also be harmful; however, Girl Math was never intended to be the core pillar for one's financial plan in life. In addition, Girl Math begat "Boy Math" and "Workplace Math" and "Boss Math" and many other maths, but the clever financial logic angle was quickly pushed aside for the ills associated with male stereotypes and issues associated with the workplace and those who are in charge. It was at this point that my efforts in keeping up with and focus on Girl Math were also pushed to the side and I moved onto the next big math story. Until, that is, a 2027 Chrysler Pacifica drove across my television screen with weird floating equations while I was watching a hockey game.

Listening to those early Girl Math segments on ZM Radio, Girl Math was its own genre. It even started a cultural movement, arguably. Girl Math was new, raw, unfiltered, energetic and entertaining. Sure, it made you laugh, but it also made you think. Perhaps the best way to describe Girl Math, in the early days, was "Punk". However, and it's a story and a lesson as old as time itself, once you put something out into the world, whether an idea or art or music, Punk or not, you relinquish ownership over how others interpret and use said ideas, art or music. Look, I never thought that I would hear "Blitzkrieg Bop" by the Ramones in a commercial for Diet Pepsi. I never, ever thought that I would hear "Rock and Roll" by Led Zeppelin in, of all things, a commercial for Cadillac. I also never thought that I would see Girl Math used in a car commercial. Then again, with respect to that last one, I didn't. To be clear, Parent Math is not Girl Math. Not even close.

Akin to how Facebook plummeted in popularity when everyone's parents started using the platform, I originally thought that the "Parent Math" campaign for the 2027 Chrysler Pacifica had, officially, killed Girl Math. The more I think about it, Girl Math isn't dead. Afterall, unlike Led Zeppelin and the Ramones, the founders of Girl Math were not paid by Chrysler (to the best of my knowledge), which means they didn't go corporate, they didn't sell out. Girl Math can still be Girl Math if presented properly.

Please keep Girl Math in mind if you ever consider bringing commercial mathematics into your math class for financial literacy/education. If you're looking, perhaps, to bring in a more sanitized, safer, corporate version of Girl Math, like Parent Math, know two things. First, it'll probably be, as the kids say, an epic failure. Second, I get it, we take less risks as we get older in life. Maybe it's time to give Dr. Rick a call. Afterall, not even Progressive Insurance can protect you from becoming your parents.

Is AI after our jobs as research mathematicians?

Contributed Article

George A. Grätzer

Abstract. Can ChatGPT, available to ordinary users, contribute to mathematical research? I describe an experiment in which I asked it to find a shorter proof of a theorem on finite ordered sets.I had just found such a proof myself.

Given the relevant papers and a brief prompt, it produced a short proof in about five minutes, using an approach entirely different from mine. The experience made the question in the title rather personal.

First they came for the socialists, and I did not speak out—because I was not a socialist.
Then they came for the trade unionists, and I did not speak out—because I was not a trade unionist.
Then they came for the Jews, and I did not speak out—because I was not a Jew.
Then they came for me, and there was no one left to speak for me.

Martin Niemöller
Luddites of the world, unite. After Karl Marx

1. Introduction

In two recent editorials, Robert Dawson [1, 2] gives an interesting narrative of what happened when OpenAI decided to spend millions of dollars solving a whole bunch of old mathematical problems.It hit pretty close to home.

Let me explain. In 1963, the following result was published [12]: Let L be an algebraic lattice. Then there exists an algebra A such that the congruence lattice of A is isomorphic to L. Soon thereafter, this result became known as the Grätzer-Schmidt Theorem. At about the same time, the term “finite Grätzer-Schmidt Theorem” was introduced. This was not a theorem, but an open problem: If L is finite, can A be chosen to be finite?

2020 Mathematics Subject Classification. Primary 06A07; Secondary 06B05. Key words and phrases. Artificial intelligence, ChatGPT, mathematical research, ordered sets, order-preserving maps. And the expenditure of millions of dollars resulted in a negative answer to this question. But this article is not about OpenAI's expenditure of millions of dollars solving old mathematical problems. It is about the ChatGPT that is available to you and me.

2. Customer Support

Most of us first experienced AI replacing people in customer support. Most of it was not very good, and we had to shout, "I want a live agent!" many times before we were connected to somebody who could answer our questions. But this is changing. A few weeks ago, I was very anxious to try out some new features of macOS 27, so I installed a beta version. Unfortunately, it was so buggy that I had to go back to macOS 26. This is not easy.

You can easily upgrade an operating system on a Mac, but downgrading it is very complicated. I called up Apple and got the AI customer support, which held my hand through the difficult and, complicated procedure with complete success. First they came for the customer support specialists, and I did not speak out—because I was not a customer support specialist.

3. Programmers

A few months ago, there were several newspaper articles explaining why new graduates with computer science degrees cannot get jobs as program-mers: AI programs better. Then they came for the programmers,and I did not speak out because I am not a programmer.

4. Research mathematicians

After I uploaded an article to arXiv, it warned me that I was allowed only two articles per month; there were too many submissions. We have all heard from mathematics journals how they are inundated with AI-written articles.

But how do we measure the effectiveness of the AI available to you and me in writing mathematical articles? I was given a unique opportunity to test this.Let me set the stage. For the ordered sets A and B, let AB denote the or-dered set of all order-preserving maps from B to A, ordered componentwise.

In 1978, Dwight Duffus proposed the following problem in his Ph.D. the-sis [3]: Let A and B be finite nonempty ordered sets. If AA is isomorphic to BB , does it follow that A is isomorphic to B? Equivalently, can we recover A from AA?

The References include publications on this topic from the late 1970s and the 1980s. J. D. Farley reignited interest in the problem in the early 2020s. This problem has recently been solved by J. D. Farley and G. Grätzer [9]. The proof is fairly long and it utilizes deep results of J. Hashimoto [13], L. Lovász [14], and R. McKenzie [15]. It was a logical next step to look for a shorter proof. I found one; see Sections 2 and 3 of G. Grätzer [10]. This gave me a unique opportunity to see if ChatGPT is as good at finding a short proof as I am. Note that I am very well qualified to find a short proof because of my background in lattice theory; see G. Grätzer [11]. I uploaded to ChatGPT all relevant papers from the References with a brief prompt: Find a short proof. ChatGPT, in about 5 minutes, re-sponded with the short proof, see Section 4 of G. Grätzer [10]. The approach of ChatGPT is completely different from mine. So I have a short proof and ChatGPT had a short proof, both published in [10]. Then they came for the mathematicians, and there was no one left to speak for me.

5. Outlining the three proofs

5.1. The idea all three proofs share. The height of X is the length of a longest chain. Along a chain in XY each of the $|Y|$ values can rise at most height(X) times, and such a chain is easy to build, so height(XY) = $|Y|$ height(X).

Call an interval [a, b] of X of maximum height if its height is height(X), and let MaxInt(X) be the set of these intervals. Intervals are bounded, and bounded ordered sets are exactly the ones whose powers are tame.Let Y1, . . . , Yr be the components of Y . If [f, g] is a maximum-height interval of XY , the count above forces each [f (y), g(y)] to have maximum height in X, so f (y) is minimal and g(y) is maximal in X; comparable minimal elements coincide, so f and g are constant on each component, and [f, g] = IY1 1 × · · · × IYrr , Ii ∈ MaxInt(X). Conversely every choice of the Ii arises, and the correspondence is a bijection. For connected A this says that the maximum-height intervals of E = AA are the powers LA with L ∈ MaxInt(A): the exponent A reappears, attached to a bounded base. Two difficulties remain, and the proofs diverge exactly here. (i) There are many maximum-height intervals; for disconnected A they are mixed products. What well-defined object does E yield? (ii) One needs a logarithm with L(LA) = A × L(L) for bounded L, and then a way to divide by the unknown L(L).

5.2. The long proof. Logarithm. Farley and Grätzer build it from structure theory. For bounded P every map in P Y is joined to a constant map, soP Y equals the suborder Con(P, Y) of components containing maps constant. on each component of Y . McKenzie's normal form writes every connected directly indecomposable D uniquely as D = Con(ED, FD) with ED absolutely indecomposable and FD connected; a power by connected Y keeps ED and replaces FD by FD × Y . With Hashimoto's factorization P = D1 × · · · × Dk, put Tow(P) = FD1 + · · · + FDk . Then Tow(P Q) = Tow P + Tow Q, Tow(P Y) = Y × Tow P (P bounded), and height(Tow P) < height P for nontrivial P . This is a genuine logarithm on all connected ordered sets, resting on two deep theorems. One interval. For (i) the long proof selects a single interval. It constructs, in three lexicographic steps (exponent vectors of Hashimoto factorizations, then normal-form pairs, then multiplicity functions), a linear ordering $\preceq$ of the isomorphism types of connected ordered sets with $P \prec Q \Rightarrow P \times R \prec Q \times R$ and $P\,Y \prec QY$. Then Max(X), the $\preceq$-greatest element of MaxInt(X), is well defined and satisfies Max(XY) = Max X × Max Y and Max(XY) = Max(X)Y . Reconstruction. With L = Max A and R = Tow L, the rules give, from E alone, U = Tow(Max E) = R × A, V = Max U = Max R × L, W = Max(Tow V) = Max R; the last step uses the height drop to see which summand of Tow V = Tow(Max R) + R carries the top intervals. Cancelling W in V gives L, hence R; cancelling R in U gives A. Cancellation is again Hashimoto: encode an or- dered set as a polynomial in indeterminates indexed by indecomposables and cancel in the polynomial ring. Iterating the same operations handles towers such as (AA)A and A(AA), and every bracketing of at most four copies of A.

5.3. The elementary replacements. Both short proofs keep the interval lemma and discard the rest. Logarithm from lower covers. Let J(B) be the elements with exactly one lower cover. For bounded B, the elements of BY with a unique lower cover are the maps equal to some $j \in J(B)$ on a principal up-set ↑ y and to oB elsewhere: lowering a map at a minimal point of its support yields a lower cover, so uniqueness pins down one point, one value, and no variation above. Hence J(BY) = J(B) × Y ∂ ; and since a cover in a product moves one coordinate along a cover, J(BC) = JB + JC. With L(B) = J(B)∂ this is exactly the three-line behaviour of Tow, now for bounded B only, including the height drop, and it takes a page to prove. All intervals instead of one. The interval lemma is a bijection MaxInt(XY) ↔ MaxInt(X)r, and the top intervals of XY are the products I × J. Any symmetric function of all the intervals therefore inherits product and power rules, with no ordering of isomorphism types. Cancellation by counting. For connected Z let hom(Z, X) be the number of order-preserving maps Z → X; it is additive on sums, multiplicative. on products, and positive. Lovász (1967): if hom(Z, X) = hom(Z, Y) for all connected Z, then X = Y ; the ordered-set case has a short inclusion–exclusion proof. So XT = Y T implies X = Y : apply hom(Z, –) and divide by hom(Z, T) > o.

5.4. First short proof: averaging. Let R+ be the nonnegative rational combinations of connected ordered sets, multiplied via direct product, an ordered set being the sum of its components. For X of positive height put Av(X) = 1 | MaxInt X| X I∈MaxInt X L(I), and extend to R+ by averaging over the top-height terms. The interval lemma and the L rules give Av(RS) = Av R+Av S and Av(XY) = Y ·Av X, and the height drop gives height(Av R) < height R. With R = Av A and S = Av B, A · R = Av(AA) = Av(BB) = B · S, hence R + Av R = S + Av S. Since Av R lies strictly below the top height of R, the top part of R+Av R is that of R; averaging it returns Av R, and subtracting returns R. So R = S, and cancelling R in AR = BR by counting gives A = B. The unknown logarithm is never computed; it identifies itself through its height drop and is divided out.

5.5. Second short proof: three invariants. To stay with integers, let M(X) be the disjoint sum of a copy of each maximum-height interval of X; then M(XY) = MX MY and M(XY) = M(X)Y . Put P = MA, with m components, and W = M(JP), with k components. From E = AA alone form U = J(ME), V = MU , Q = M(J ∗ V), with J ∗ counting upper covers. Following J through a power with disconnected base gives U = µ(JP × Að), V = µ(W × P ð), Q = µk W ð , µ = mc−1, c the number of components of A; the height drop again isolates the sum- mand of J ∗ V carrying the top intervals, and height A = height U − height Q. Now count with a fixed connected Z, once for A and once for B. The counts for Q and V divide to give kB hom(Zð , PA) = kA hom(Zð , PB), hence kB PA = kAPB and kB JPA = kAJPB . Inserting this in the count f or U , cancelling positive numbers, and using |A| = |B| (equal heights and |A| height A = |B| height B) leaves hom(Z, Að) = hom(Z, Bð) for every con- nected Z. Lovász's theorem finishes.

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Call for Nominations: 2027 CMS Blair Spearman Doctoral Prize

Calls for Nominations

The Canadian Mathematical Society (CMS) is currently accepting nominations for the 2027 CMS Blair Spearman Doctoral Prize.

Deadline: January 31, 2027. No nominations will be accepted beyond this deadline. The prize is awarded to one recipient of a Ph.D. from a Canadian university whose overall performance in graduate school is judged to be the most outstanding. Although the dissertation will be the most important criterion (the impact of the results, the creativity of the work, the quality of exposition, etc.) it will not be the only one. Other publications, activities in support of students and other accomplishments will also be considered.

Visit our website for more information:https://cms.math.ca/awards/doctoral-prize/nomination-information/

ICIAM Dianoia. Volume 14, Issue 4 Oct 2026

Announcements

ICIAM



Call For CUMC Applications | Deadline: November 30, 2026

CMS Student Committee

Hello everyone,

We want to remind everyone that applications are still open to host the 2027 CUMC (The Canadian Undergraduate Mathematics Conference)! For anyone interested in hosting the CUMC on their campus next summer, we encourage you to submit an application (Competitions are an important part of learning mathematics and a fun activity for students of all ages. The CMS supports math competitions in many ways; running our own competitions to funding regional competitions to supporting Canadian involvement in international competitions. We also provide a wide variety of resources for students to prepare for competitions. Students are able to register for more than one competition if they wish to do so.). This is a great opportunity to become more involved in the mathematics community and contribute to creating a memorable CUMC experience for participants.
Please make sure to complete and submit your application by November 30th 2026. If you have any questions about the application process or what hosting CUMC entails, please feel free to contact us at cumc-ccem@cms.math.ca.

We look forward to seeing your applications and hearing your ideas for CUMC 2027!
The CMS Student Committee

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