# Multiple discoveries and misattributions

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# Stigler's Law

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▶ (To be clear: this is not entirely serious!)

# Brown's Law

- ▶ Stigler's Law is open to disproof by counterexample.
- ▶ Brown proposed this more mathematical formulation in 2007, first discovered by Carl Boyer in 1968 (Brown and Rice, 2022):

## Theorem (Brown's Law)

*Let n be the total number of named theorems and formulae in mathematics and p(n) be the number of these results that are named after the person (or people) who originally discovered them. Then*

$$\lim_{n \to \infty} \frac{p(n)}{n} = 0.$$

# Example

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▶ Stirling's approximation, $n! \approx \sqrt{(2\pi n)} \left(\frac{n}{e}\right)^n$ for large $n$, was in fact discovered by Abraham de Moivre! (Brown and Rice, 2022)
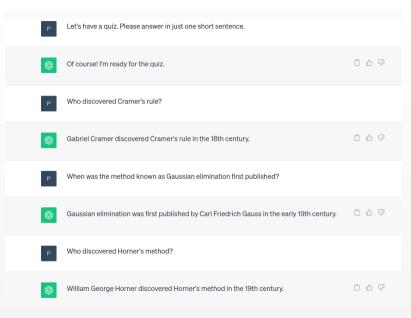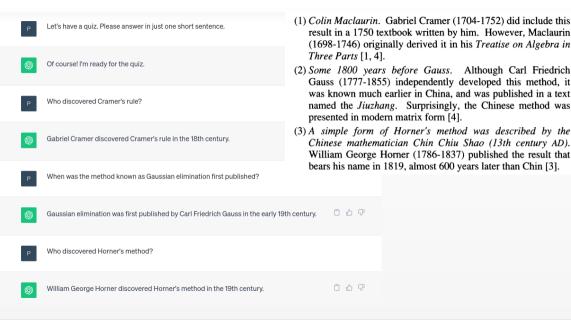
# Let's have a quick quiz

# Quiz

▶ This idea was played with by Luoma (1996a,b) in *The Mathematical Gazette*.

Test yourself with the following quiz and discover what you know about the history behind famous-name mathematics. A discussion of these questions appears on page 349.

(1) Who discovered Cramer's rule?

(2) When was the method known as Gaussian elimination first published?

(3) Who discovered Horner's method?

(4) How did L'Hôpital obtain the rule which bears his name?

(5) Did Pascal discover the Pascal triangle?

(6) Who solved the Pell equations?

(7) When was the Pythagorean theorem discovered?

(8) Who first published Simpson's rule?

(9) Who was the originator of the Taylor series?

KEITH LUOMA

**P** Let's have a quiz. Please answer in just one short sentence.

**⊛** Of course! I'm ready for the quiz.

**P** Who discovered Cramer's rule?

**⊛** Gabriel Cramer discovered Cramer's rule in the 18th century.

**P** When was the method known as Gaussian elimination first published?

**⊛** Gaussian elimination was first published by Carl Friedrich Gauss in the early 19th century.

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(1) *Colin Maclaurin.* Gabriel Cramer (1704-1752) did include this result in a 1750 textbook written by him. However, Maclaurin (1698-1746) originally derived it in his *Treatise on Algebra in Three Parts* [1, 4].

(2) *Some 1800 years before Gauss.* Although Carl Friedrich Gauss (1777-1855) independently developed this method, it was known much earlier in China, and was published in a text named the *Jiuzhang.* Surprisingly, the Chinese method was presented in modern matrix form [4].

(3) *A simple form of Horner's method was described by the Chinese mathematician Chin Chiu Shao (13th century AD).* William George Horner (1786-1837) published the result that bears his name in 1819, almost 600 years later than Chin [3].

**P** How did L'Hôpital obtain the rule which bears his name?

**⑨** L'Hôpital obtained the rule that bears his name through private correspondence with Johann Bernoulli, who provided him with the method for calculating indeterminate limits using derivatives, and L'Hôpital later published it without giving credit to Bernoulli.

**P** Did Pascal discover the Pascal triangle?

**⑨** No, Blaise Pascal did not discover Pascal's Triangle; it was known in ancient China and Persia before his time. However, he made significant contributions to its study and popularized it in Europe during the 17th century.

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The Pell equations were famously solved by the Indian mathematician Brahmagupta and later by the French mathematician Pierre de Fermat.

(4) *He purchased it from another mathematician.* L'Hôpital's rule first appears in a calculus textbook written by Guillaume L'Hôpital (1661-1704). The rule was actually the product of Johann Bernoulli (1667-1748), who sold L'Hôpital the exclusive rights to his research. In a sense, Bernoulli worked as a mathematical ghost writer [1, 4, 5].

(5) *Yes, but he was certainly not the first.* The Pascal triangle was described by the mathematician and philosopher Blaise Pascal (1623-1662) in *The Arithmetical Triangle*. However, it was known centuries earlier to Chinese and Islamic mathematicians, appearing in the works of al-Sawal in the early eleventh century and Jia Xian in the middle of that same century. It is unknown whether the result was transmitted from China through cultural contact [3, 4, 5].

(6) *Joseph-Louis Lagrange.* The equations, named for John Pell (1611-1685), were known to Diophantus (3rd century AD). Leonard Euler (1707-1783) mistakenly attributed the solution of these equations to Pell; they are actually due to Lagrange (1736-1813) [2].

**P** When was the Pythagorean theorem discovered?

**⑤** The Pythagorean theorem, although attributed to the ancient Greek mathematician Pythagoras, was likely known to earlier civilizations in Mesopotamia and India. Its discovery predates recorded history, so it is challenging to determine an exact date.

**P** Who first published Simpson's rule?

**⑤** Thomas Simpson, an English mathematician, first published Simpson's rule in his 1743 work "A New Treatise of Fluxions."

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(7) *The answer to this question is still uncertain, although it appears that several civilizations may have discovered the theorem independently.* Though the celebrated theorem is ascribed to the Greek mathematician and mystic Pythagoras (sixth century BC), the earliest preserved proof is Euclid's, although legend has it that Pythagoras possessed one. Nevertheless, the Babylonian tablet Plimpton 322, from about 1700 BC, contains a long list of Pythagorean triples, leading most historians to believe the Babylonians knew the full result. The theorem was also known in both China and India, possibly before the time of Pythagoras. Contrary to popular opinion, there is no evidence that the theorem was known in Egypt [1, 3, 5, 6].

(8) *James Gregory.* Simpson's rule appears in the 1743 *Mathematical Dissertations on a Variety of Physical and Analytical Subjects*, by Thomas Simpson (1710-1761). But Gregory (1638-1675) can claim priority for the result, it having appeared in his 1668 *Exercitationes Geometricæ* [1, 4].

(9) *James Gregory again.* The Taylor series, published by Brook Taylor (1685-1731), was known by Gregory three decades earlier. A preliminary form of it was apparently known in sixteenth century India [1].

# What's going on?

*Generative AI models "are designed to generate text based on patterns and examples present in the data they were trained on. They do not have an inherent understanding of truth or ethics and are agnostic to the factual accuracy of the information they generate."*

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▶ Fundamentally, these AI programs are "stochastic parrots": "haphazardly stitching together sequences of linguistic forms it has observed in its vast training data, according to probabilistic information about how they combine, but without any reference to meaning" (Bender, et al., 2021).

# Appropriate use

▶ The only reason I can spot these errors is because I know the topics.

▶ How did I develop this ability? Not by writing queries to AI.

▶ These tools are very good at text processing.

▶ They are not good at facts.

▶ Use the right tool for the right job.

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P Convert this to APA 7:
@inproceedings{10.1145/3442188.3445922,
author = {Bender, Emily M. and Gebru, Timnit and McMillan-Major, Angelina and Shmitchell, Shmargaret},
title = {On the Dangers of Stochastic Parrots: Can Language Models Be Too Big? 🦜 },
year = {2021},
isbn = {9781450383097},
publisher = {Association for Computing Machinery},
address = {New York, NY, USA},
url = {https://doi.org/10.1145/3442188.3445922},
doi = {10.1145/3442188.3445922},
booktitle = {Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency},
pages = {610–623},
numpages = {14},
location = {Virtual Event, Canada},
series = {FAccT '21}
}

In APA 7 format, the citation for the given reference would look like this:

Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the Dangers of Stochastic Parrots: Can Language Models Be Too Big? 🦜. In Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (pp. 610-623). Association for Computing Machinery. https://doi.org/10.1145/3442188.3445922

# Multiple discoveries

# Multiple discovery

► Sometimes, the same mathematical idea is discovered more than once.

► Sometimes, this is nearly at the same time, causing a priority dispute.

► Other times, this is an idea which was previously known in another place a long time ago.

# Why does this happen?

▶ Perhaps because people don't name ideas after themselves, others do.

▶ This makes it likely that credit will attach to a well-known person who brings a concept to greater attention, rather than the original person.

# Example: Stokes' Theorem

▶ Named after George Gabriel Stokes because of his tendency of including it on Cambridge prize examinations.

▶ However, the first statement of the theorem was by William Thompson (Lord Kelvin) in a letter to Stokes.

▶ Clearly, Stokes would have been aware of Kelvin's work and presumably didn't claim to have originated the theorem.

# Newton/Leibniz

▶ A famous priority dispute occurred between Isaac Newton and Gottfried Wilhelm Leibniz over the invention of the calculus.

▶ They probably had discovered calculus independently.

▶ This led to an investigation by the Royal Society and a dispute that effectively separated English mathematicians from those in continental Europe for many years.

# Discovery of previously-known ideas

▶ There are many concepts that were discovered in Europe, where we get our name for them, despite having been known previously by non-European cultures.

▶ For example, Pascal's triangle, named for Blaise Pascal (1623–1662), though it had been studied centuries earlier in India, Persia, China and even in other parts of Europe.

▶ The Fibonacci sequence had been studied in India centuries before Fibonacci.

▶ It may be that Pascal and Fibonacci rediscovered something forgotten, or that they knew about the idea from the earlier source.

# Not always advancing

▶ We tend to think of mathematics as a body of knowledge to which new ideas are added.

▶ Ideas that are discovered, forgotten and then subsequently rediscovered, perhaps centuries later, give us the notion that maths isn't an ever-advancing, coherent body of knowledge.

▶ Instead, it may be that parts of maths are forgotten and lost; that we are not always advancing.

▶ Treating older mathematics as more primitive and assuming that we are always adding to our body of knowledge over time is a trap to be aware of when reading and writing about history.

# References

▶ Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the Dangers of Stochastic Parrots: Can Language Models Be Too Big? In Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (pp. 610–623). Association for Computing Machinery. https://doi.org/10.1145/3442188.3445922

▶ Brown, E. & Rice, A. (2022). Brown's Law of Mathematical Eponymy; or, Whose Theorem is It Anyway? *Math Horizons*, 30(2), pp. 5–7, https://doi.org/10.1080/10724117.2022.2112891

▶ Luoma, K. (1996a). What's in a name? A quiz on 'famous-name' mathematics. *Mathematical Gazette*, 80, p. 297.

▶ Luoma, K. (1996b). The truth behind 'famous name' mathematics. *Mathematical Gazette*, 80, pp. 349–351.