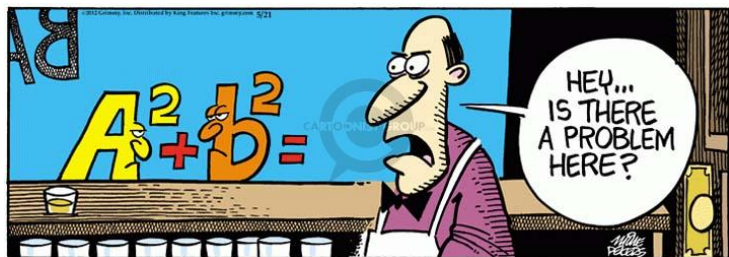


Controversy in Proofs:

Equations, Computers, Visualization, & Representations



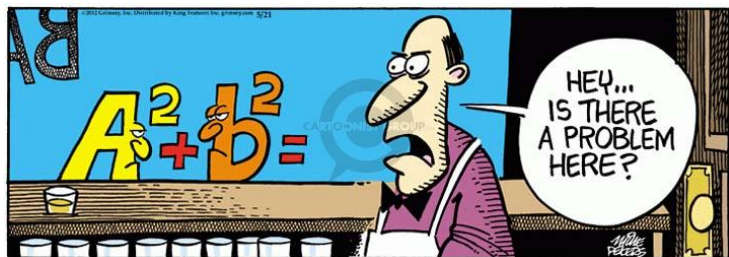
Think of an equation that is important or interesting.

Write down:

- The equation or its name
- Why you choose this equation
- What it is trying to tell us about mathematics or the world

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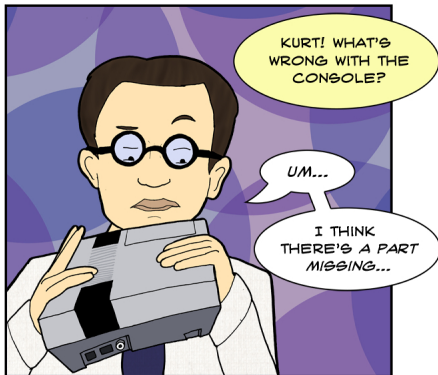
Share and rank the equations in order of their *truth*.

Controversy: Empirical versus Platonic

- Empirical: approximate relational fits to experimental data
- Platonic: derived from axioms

Controversy: Empirical versus Platonic

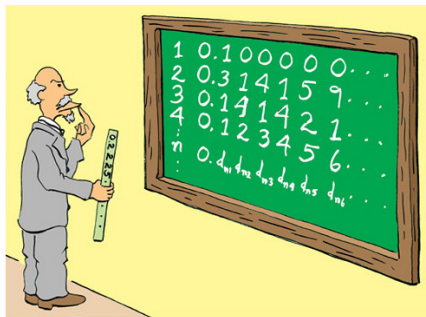
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[Gödel's incompleteness theorems]



GÖDEL'S INCOMPLETE NES THEOREM

Controversy: Comparing Infinite Quantities

- Galileo Galilei (1564-1642): ~~sizes of infinite sets~~
- Georg Cantor (1845-1918)
 - revolutionary ideas on the comparison of infinite sets
 - basis of many ideas in modern mathematics, including analysis and calculus
 - mathematicians and theologians strongly objected that the work challenged the uniqueness and infinity of God
 - no recognition during his lifetime



George showed it wouldn't fit in.

Proofs Change Over Time : $e^{i\pi} = -1$

- *It is absolutely paradoxical; we cannot understand it, and we don't know what it means, but we have proved it, and therefore we know it must be the truth. [Benjamin Peirce, 19th century]*

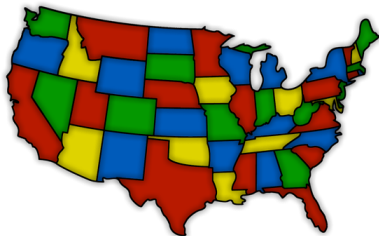
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- *Like a Shakespearean sonnet that captures the very essence of love, or a painting that brings out the beauty of the human form that is far more than just skin deep, Euler's Equation reaches down into the very depths of existence. [Keith Devlin]*



Controversy in Computer Proofs

- Four color theorem first major theorem proved by computer (Kenneth Appel and Wolfgang Haken, 1976), more than 1000 hours of computer time.

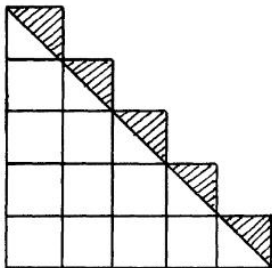


- Objections from Thomas Tymoczko and others
 - not practically verifiable
 - could be defects in the runtime environment and hardware
 - could have errors in the computer software

Proof is in the Picture?

- “A key question raised by the intensified study of visualization is whether, or to what extent, visual representations can be used, not only as evidence or inspiration for a mathematical statement, but also in its justification”

$$1 + 2 + 3 + \cdots + n = \frac{n^2}{2} + \frac{n}{2}$$



Controversy in Representations

**3 OUT OF 2
PEOPLE
— HAVE —
TROUBLE
— WITH —
FRACTIONS**

Controversy in Representations



Watch the video:

<http://www.youtube.com/watch?v=AKYZhdbnOWM>

Controversy in Representations

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Dennis Deturck: *Despite the fact that great historical and theoretical significance has been imported to fractions and rational numbers, its study should be deferred until it's really needed and can be appreciated, which may not be until after somebody learns calculus.*

💡 Reflect on the speech. Share aspects that surprised you, aspects that you agreed or disagreed with, and aspects related to your own life

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💡 What are topics that were once taught and are no longer in the curriculum?

💡 What other areas and equations do fractions impact?