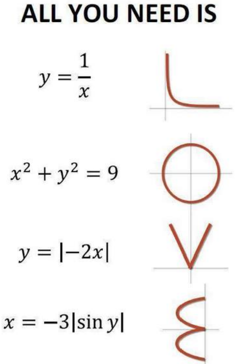
Mathematical Breakthroughs

- Mathematics research is like genealogical research–answers why
- Chose geometry because it is the most rewarding even though visualization does not come easily for me
- Count on my fingers



A Rough Beginning to my Career: Freshman Year

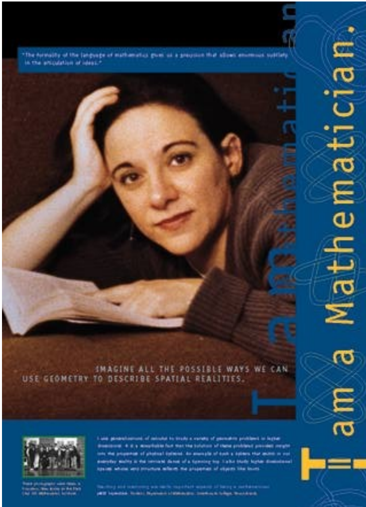
- Our mother instilled the beliefs: try things at least once, work hard

Freshman Year:

- Failed first test in college but improved to B+
- Guardian of my brother
- *Simpsons* on Sundays

Diversity Issues

- Physics and computer science high school teacher
- “You don’t look like a mathematician”



Representations of Spaces and Mathematics in Society

- **Analogy**: How do we know whether two fractions are the same? $\frac{14038227}{2351281419} \xrightarrow{?} \frac{3521}{589737}$

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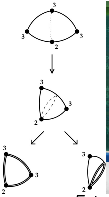
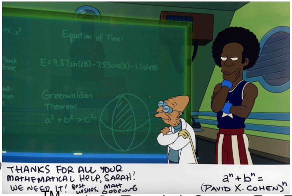
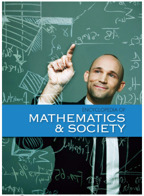
- Representations of Spaces, Mathematicians, and Mathematics in Society & Teaching







Futurama TM and © Twentieth Century Fox Film Corporation.

$$\left(\frac{SurfaceArea(\mathcal{O})}{4\pi}\right)\frac{1}{t} + \left(\frac{1}{64\sqrt{\pi}} \int_{MirrorLocus(\mathcal{O})} \tau\right)\sqrt{t} + \frac{\chi(\mathcal{O})}{6} + \ldots$$

Working with Others

Erdős-Bacon number: 7 or ∞

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Six degrees of Kevin Bacon:

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Six degrees of Kevin Bacon: 3 or ∞

Futurama: Bite My Shiny Metal X (documentary short) $\xrightarrow{\text{David X Cohen}}$ *I*
Know that Voice (documentary) $\xrightarrow{\text{Ed Asner}}$ *JFK* (1991) $\xleftarrow{\text{Kevin Bacon}}$

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Paul Erdős number: 4

Asymptotic expansion of the heat kernel for orbifolds $\xrightarrow{\text{Carolyn S. Gordon}}$ *Boundary volume and length spectra of Riemannian manifolds: what the middle degree Hodge spectrum doesn't reveal* $\xrightarrow{\text{Jaun Pablo Rossetti}}$ *Hearing the platycosms* $\xrightarrow{\text{John Conway}}$ *On the distribution of values of angles determined by coplanar points* $\xleftarrow{\text{Paul Erdős}}$

Research on Representations of Mathematics in Society

Research on Representations of Mathematics in Society

Apu insists that he has an excellent memory:
In fact I can recite π to 40,000 places. The last digit is one!
[Marge in Chains]

How many digits of π do you know? What is the probability that Apu is correct if he randomly guessed?

Hideaki Tomoyori: World Record 1987-1995

For example, the number sequence three-nine in Japanese is pronounced san-kyu, and that sounds very like the word sa-kyu, which means "sand dune". If I picture a sand dune, I easily remember the numbers three and nine. And if I add in other elements, like my wife standing in front of the sand dune by the bright sea, then those words in Japanese can remind me of a whole string of ten numbers.

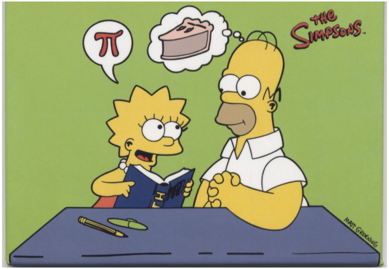
Hideaki Tomoyori: World Record 1987-1995

I feel that human abilities really have no limits. It's often said that we use just about five percent of our brain cells, so I think we have much greater potential - and I want to pursue that potential. So I want to go on with the challenge of memorizing π*, for just the same reason that people climb high mountains. I think it's a wonderful thing to challenge the limits of what we can do... the more one memorizes of it, the closer one comes to the real value of the circle - closer to perfection.*

Research on Hideaki Tomoyori: World Record 1987-1995

Researchers compared his cognitive abilities with a control group and concluded that they were not superior; they attributed his achievement to extensive practice.

Apu is Correct



- The 40,000th digit of π is one if he is counting digits following the decimal point

3.141592653589793238462643383279502884197169399375105820974944592307816406286208998628034825342117
0679821480865132823066470938446095505822317253594081284811174502841027019385211055596446229489549
3038196442881097566593344612847564823378678316527120190914564856692346034861045432664821339360726
0249141273724587006606315588174881520920962829254091715364367892590360011330530548820466521384146
9519415116094330572703657595919530921861173819326117931051185480744623799627495673518...

1507814685262133252473837651...

Researching 1 Billion Digits of π

$$\frac{1}{\pi} = 12 \sum_{k=0}^{\infty} \frac{(-1)^k (6k)!(545140134k + 13591409)}{(3k)!(k!)^3 (640320)^{3k+\frac{3}{2}}}$$

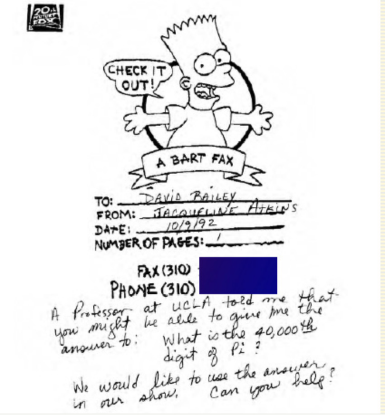
David and Gregory Chudnovsky (1989). Their algorithm is used by computer algebra software.

- **David**: *Maybe in the eyes of God π looks perfect... π is the best stress test for a supercomputer*
- **Gregory**: *π is a damned good fake of a random number... It cannot be that π is truly random? Actually, a truly random sequence of numbers has not yet been discovered.*
- **David**: *Exploring π is like exploring the universe.*
- **Gregory**: *It's more like exploring underwater. You are in the mud, and everything looks the same... Our computer is the flashlight*

Marge in Chains: The Simpsons

Al Jean

The 40,000th digit of π is 1



CHECK IT OUT!

A BART FAX

TO: DAVID BAILEY
FROM: JACQUELINE ATKINS
DATE: 10/9/92
NUMBER OF PAGES: 1

FAX (310) [redacted]
PHONE (310)

A Professor at UCLA told me that you might be able to give me the answer to: What is the 40,000th digit of Pi?

We would like to use the answer in our show. Can you help?

The 40,000th digit of π is 1

Bailey, Borwein and Plouffe, 1996

$$\pi = \sum_{i=0}^{\infty} \frac{1}{16^i}\left(\frac{4}{8i+1} - \frac{2}{8i+4} - \frac{1}{8i+5} - \frac{1}{8i+6}\right)$$

The 40,000th digit of π is 1

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The Simpsons: 22 Short Films About Springfield

Outside Interests

- Hiking
- Music
- Travel

Jeff Westbrook: *Nothing trains you better and gives you more analytical skills than mathematics. That skill is useful in the craziest places you might imagine: writing a TV show, writing a cartoon, and lawyering perhaps.*