Ruby and π

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Happy π Day!

What is π? Apple pie?

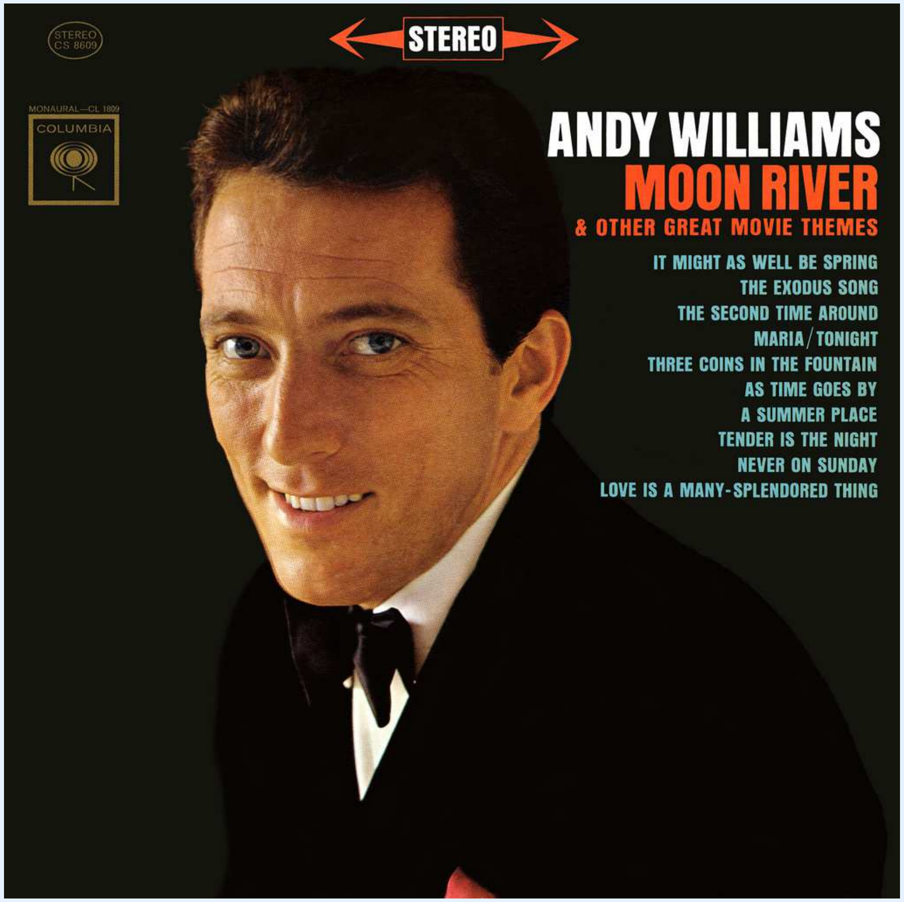
What is π? Blueberry pie?

What is π? Huckleberry pie?

What’s a huckleberry?

HUCKLEBERRY FINN.

What's a huckleberry?



Huckleberry? It’s basically a blueberry.

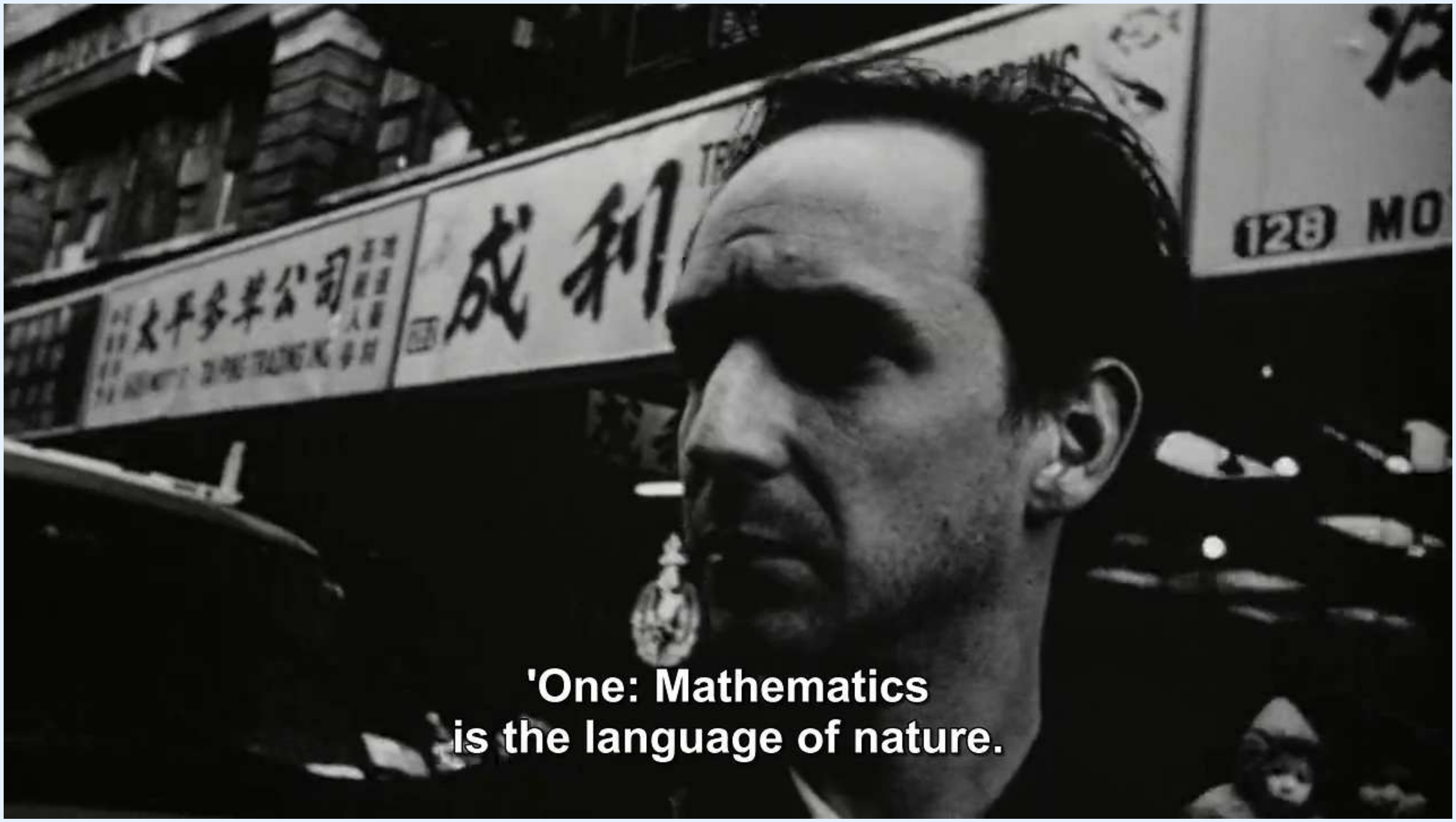
We're going to need to think about this one.

THINKING IT OVER.

What is π?

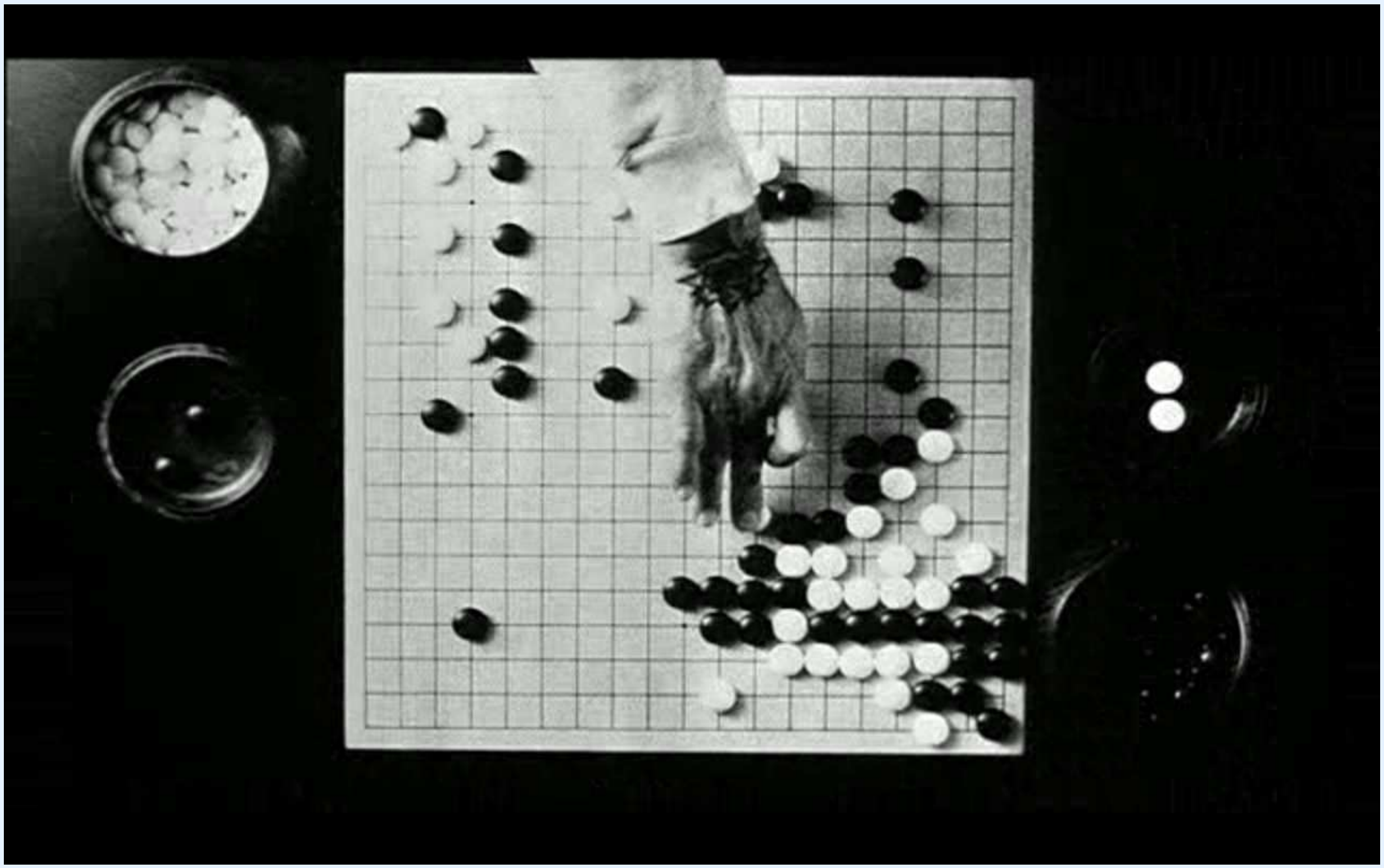
3.14159265358979323846264338327950288419716939
937510582097494459230781640628620899862803482
534211706798214808651328230664709384460955058
223172535940812848111745028410270193852110555
964462294895493038196442881097566593344612847
564823378678316527120190914564856692346034861
045432664821339360726024914127372458700660631
558817488152092096282925409171536436789259036
001133053054882046652138414695194151160943305
727036575959195309218611738193261179310511854
807446237996274956735188575272489122793818301
194912983367336244065664308602139494639522473
719070217986094370277053921717629317675238467
481846766940513200056812714526356082778577134
275778960917363717872146844090122495343014654...

Why should we care about π?



Mathematics and computers are deeply intertwined.

Mathematics is a language that let’s us truly understand how games work.



If we understand mathematics, maybe we can therefore understand God's grandest game? Maybe God will play a game with us?

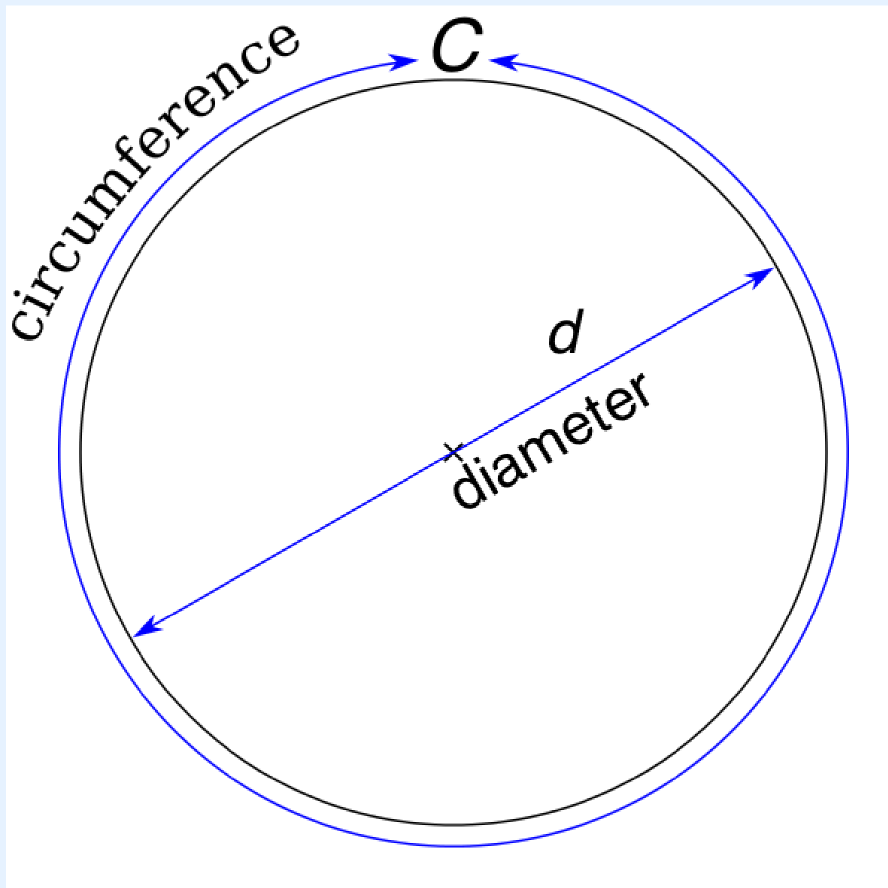
Or maybe that's just crazy?

Sean Gullette in Pi (1998). *filmOA magazine*

You can get a greatly abbreviated approximation of π in Ruby quite easily.

```
Math::PI
=> 3.141592653589793
Math.sin Math::PI
=> 1.2246467991473532e-16
Math.cos Math::PI
=> -1.0
Math.tan Math::PI
=> -1.2246467991473532e-16
2 * Math.asin(1)
=> 3.141592653589793
Math.acos -1
=> 3.141592653589793
```

π is the ratio of a circle's circumference to it's diameter, $\pi = \frac{C}{d}$.



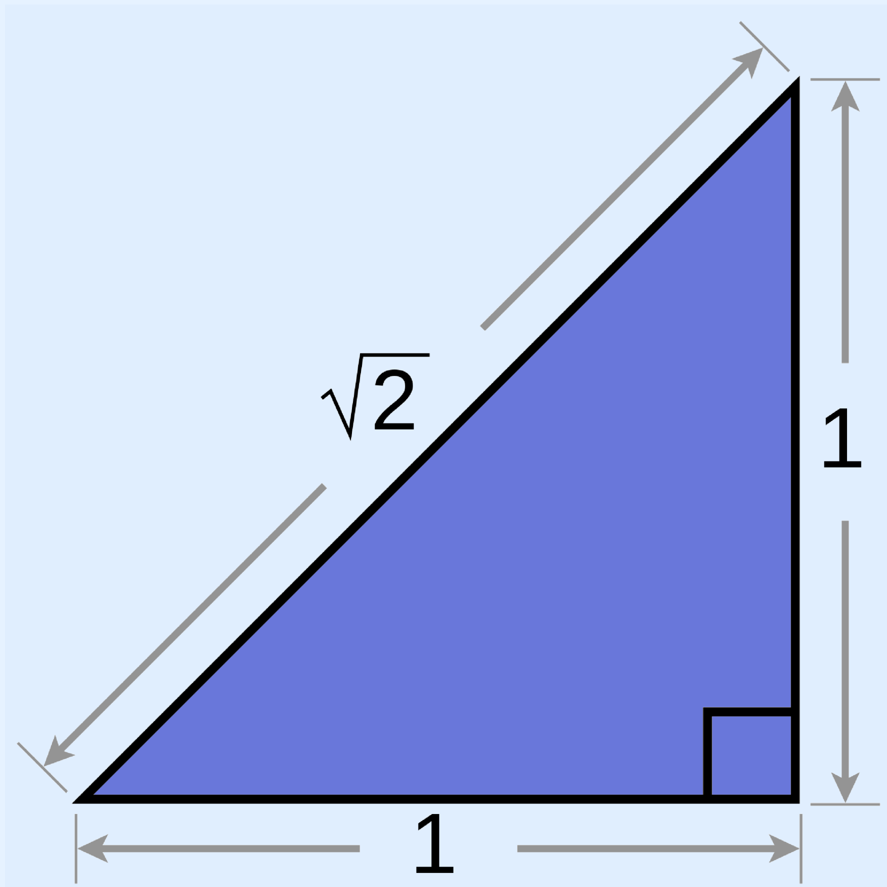
π is an irrational number.

Irrational meaning it can't be expressed as a fraction. There are no integers a and b such that $\pi = \frac{a}{b}$.

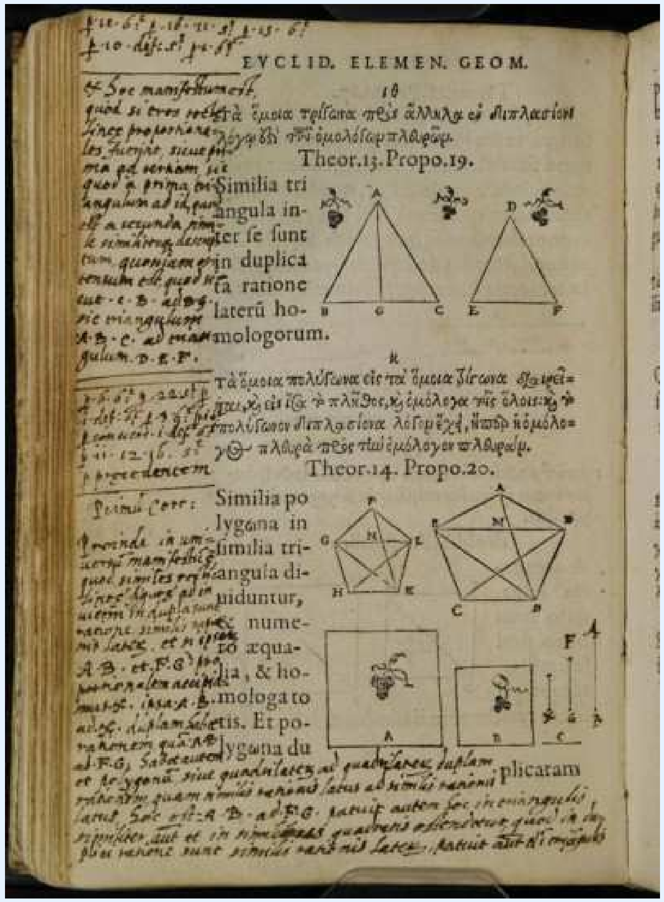
Hippasus of Metapontum, founder of the Mathematikoi school of the Pythagoreans, proved it *(probably.)*

The Pythagoreans took mathematics *really* seriously. They threw Hippasus overboard for proving π was irrational. *(Or possibly for $\sqrt{2}$.)*

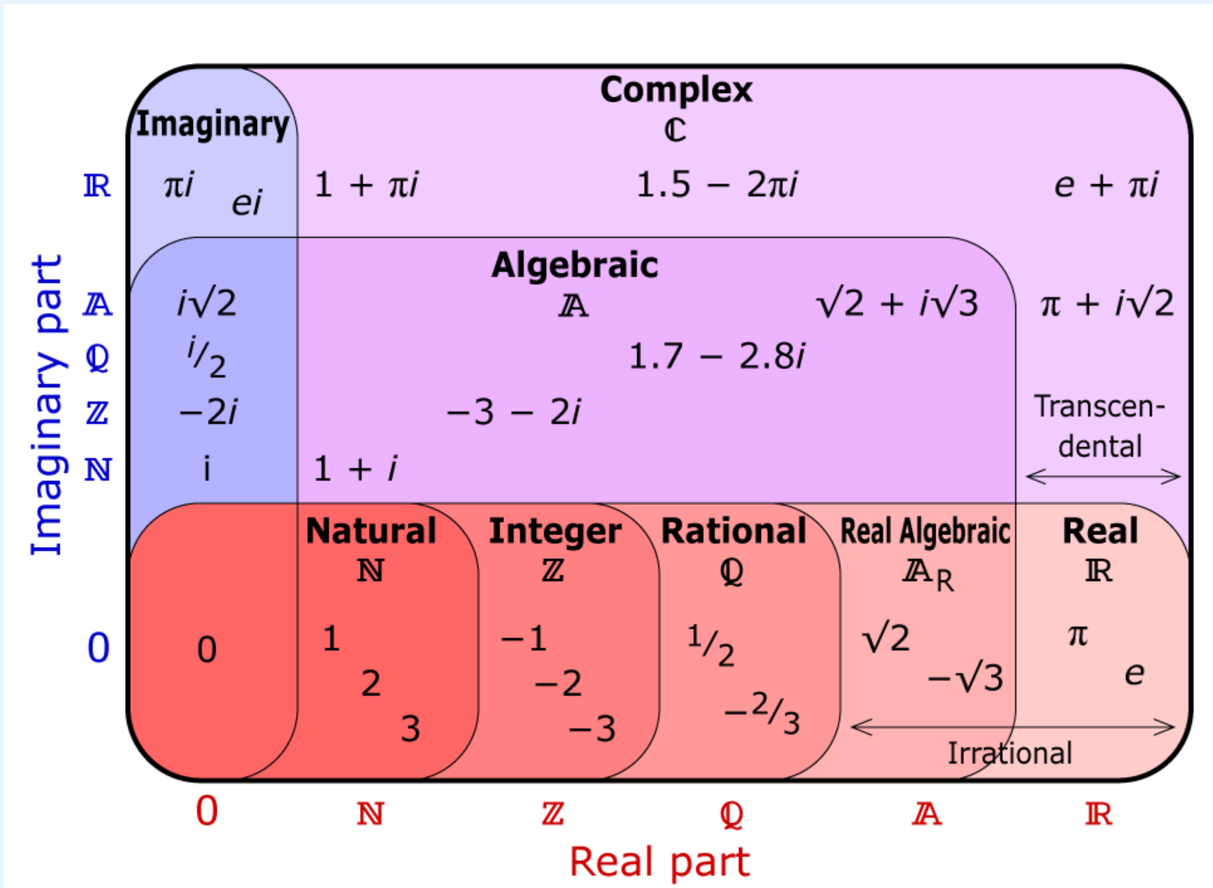
Proving that $\sqrt{2}$ is irrational is easier than proving π. We're not sure which was proven first though.



One of the main reasons the Ancient Greeks went so far with Geometry in preference to Algebra was because of irrational numbers.



π is a transcendental number. You can't express it as a polynomial.



Let's calculate π!

Basic algorithm[a]: $\frac{4}{1} - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \frac{4}{9} - \ldots$

```
def gimme_pi(n)
  num, den = 4.0, 1
  pi = 0
  plus = true
  while den < n
    if plus
      pi = pi + num/den
    else
      pi = pi - num/den
    end
    plus = not plus
    den = den + 2
  end
  pi
end
```

[a] http://alvinalexander.com/blog/post/ruby/calculating-pi-with-ruby

```
gimme_pi 1
# => 0
gimme_pi 10
# => 3.3396825396825403
gimme_pi 100
# => 3.1215946525910110
gimme_pi 1_000
# => 3.1395926555897850
gimme_pi 10_000
# => 3.1413926535917910
gimme_pi 100_000
# => 3.1415726535897814
gimme_pi 1_000_000
# => 3.1415906535896920
gimme_pi 10_000_000
# => 3.1415924535897797
gimme_pi 100_000_000
# => 3.1415926335902506
```

Why π?

Welsh mathematician William Jones in his 1706 work *Synopsis Palmariorum Matheseos*; or, *a New Introduction to the Mathematics*. He used π for *“1/2 of the periphery”*, the periphery being the circumference.

And then Euler copied Jones' usage of π for the ratio in his works, giving it permanence.

Euler's Identity, $e^{i\pi} + 1 = 0$

Five very important constants:

- Euler's number (a.k.a. Napier's constant), e
- The imaginary unit, $i = \sqrt{-1}$
- π of course
- The additive identity, 0
- The multiplicative identity, 1

Three basic operations happen exactly once: addition, multiplication, and exponentiation.

What about τ?

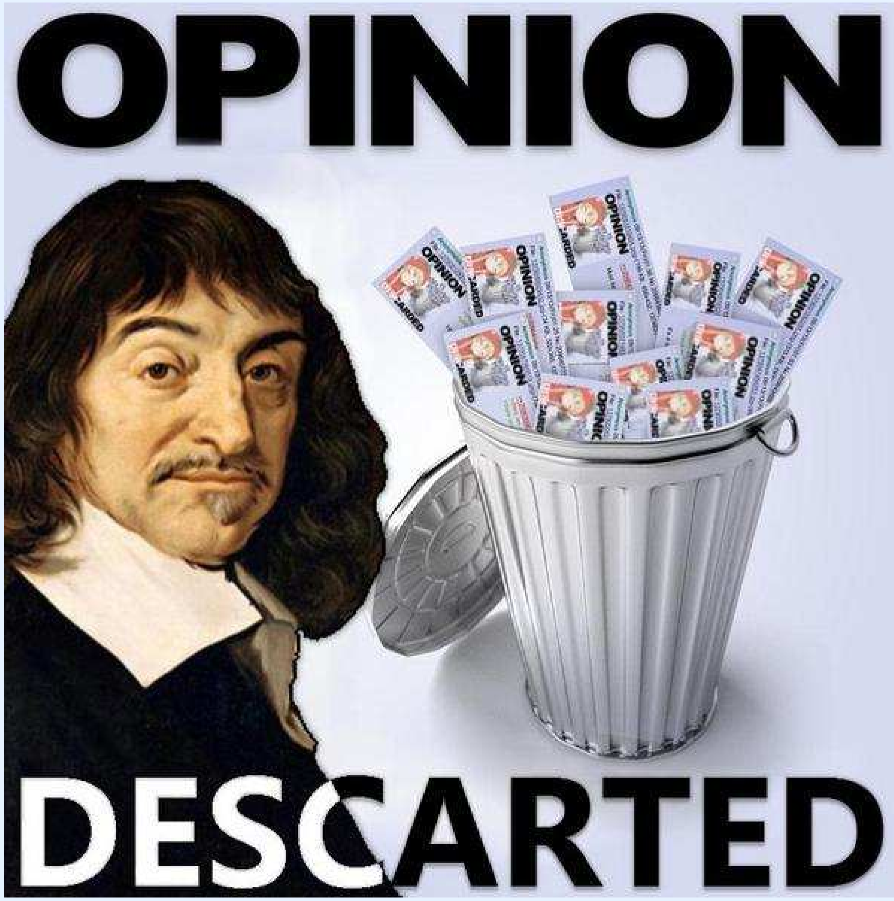
A few years ago Michael Hartl started arguing for using

$$\tau = 2\pi \approx 6.283185\ldots$$

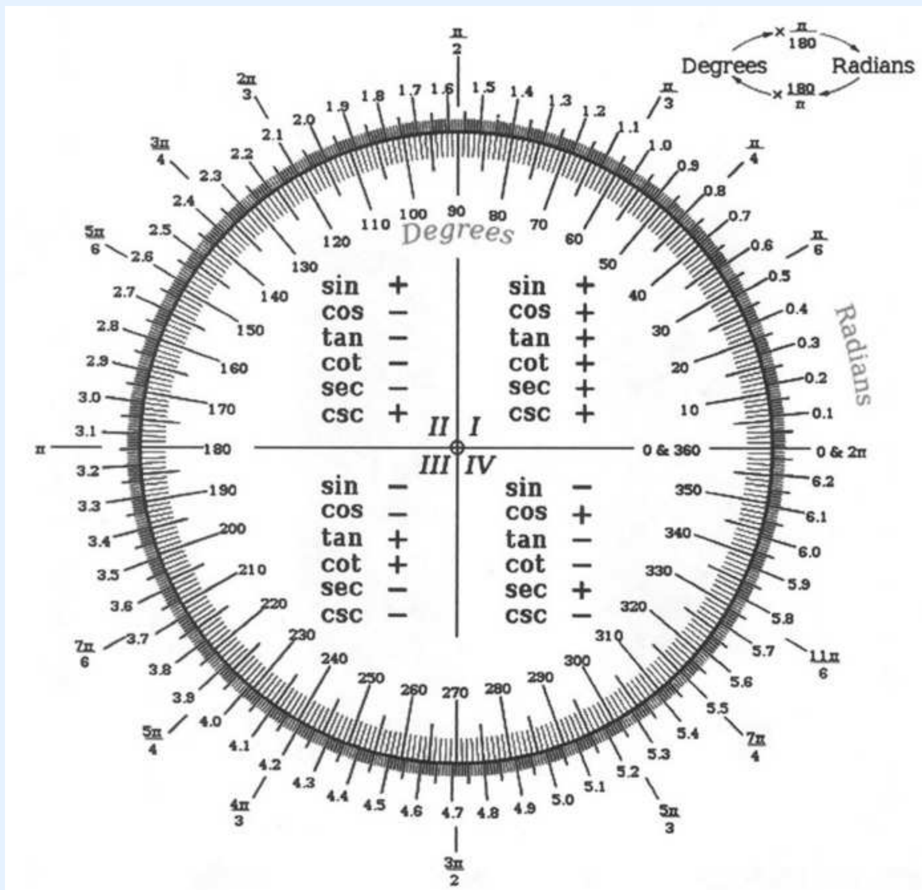
as the primary constant instead. There's a few reasons why that's a bad idea.

- Somebody in the 1950's was using $\tau = \frac{1}{2}\pi$, and that actually got some currency, so we'd then have $\tau = 4\tau$, which is just silly.
- Pie tastes awesome. What's tau taste like? Maybe yong tau foo? Looks tasty, but not as tasty as pie.
- We don't have an STL Ruby meeting on 6/28/2016.

And most importantly, τ is trying to make math easier, but math's not supposed to be easy.



Degrees are kind of weird? That's because they date back to the Babylonians. Let's switch to radians! $2\pi^{\text{rad}} = 360°$



Questions?