Ruby and π

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Happy π Day!

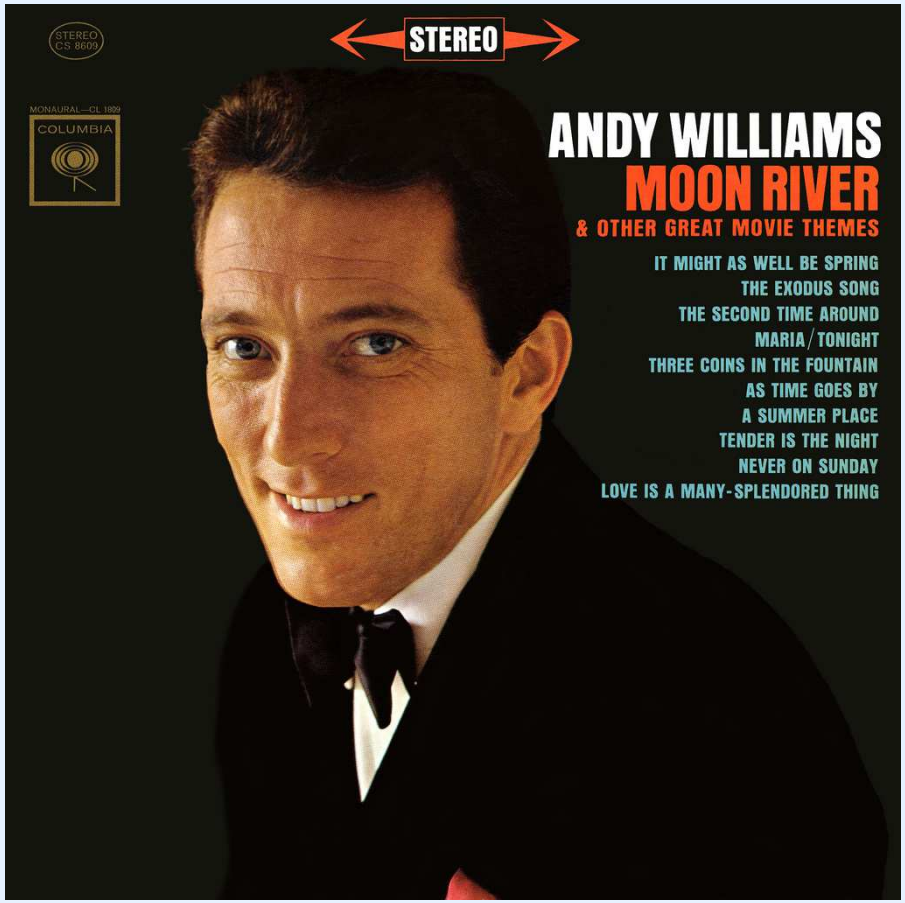
What is π? Apple pie?

What is π? Blueberry pie?

What is π? Huckleberry pie?

What's a huckleberry?

What's a huckleberry?



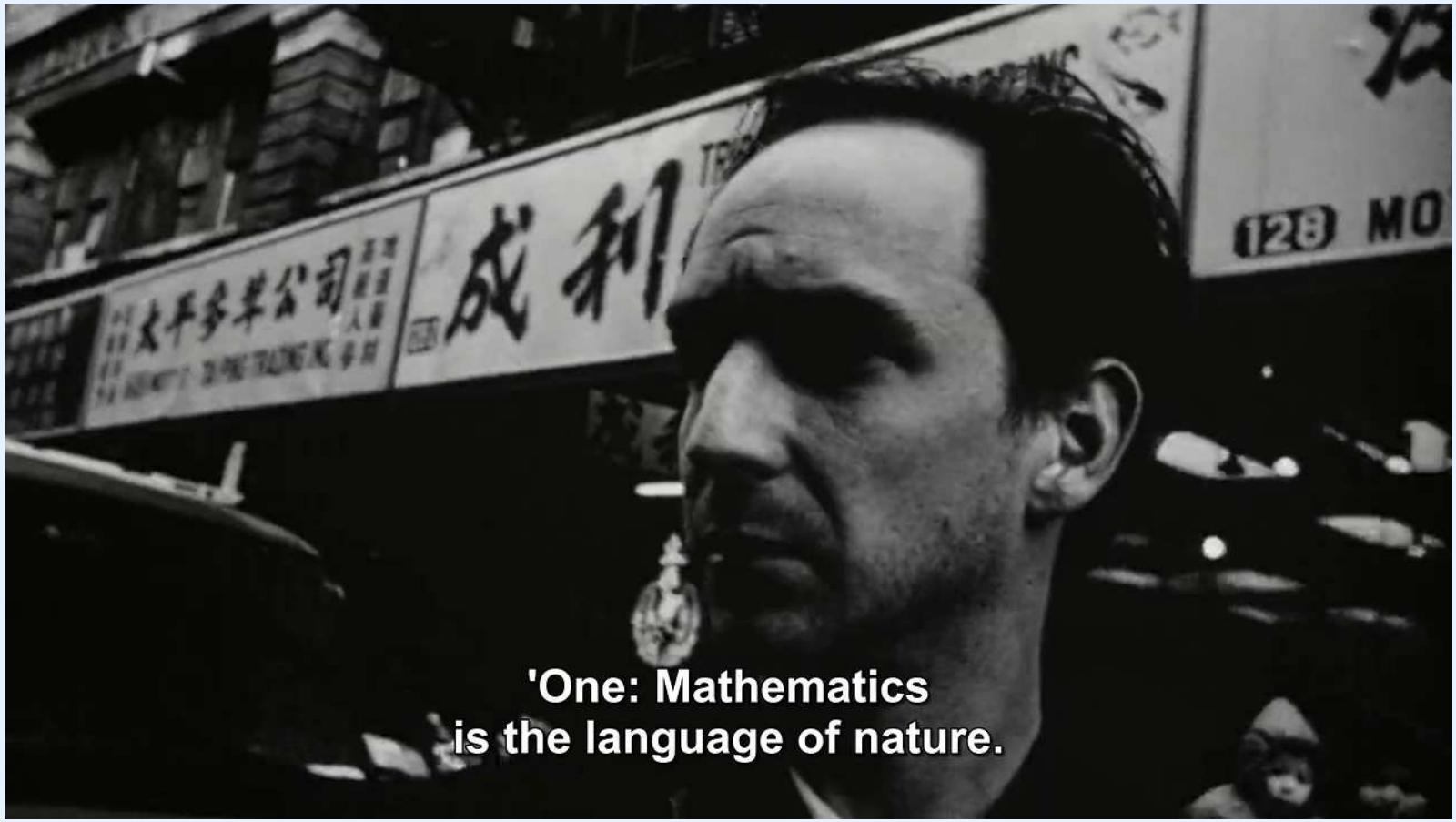
Huckleberry? It's basically a blueberry.

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

What is π?

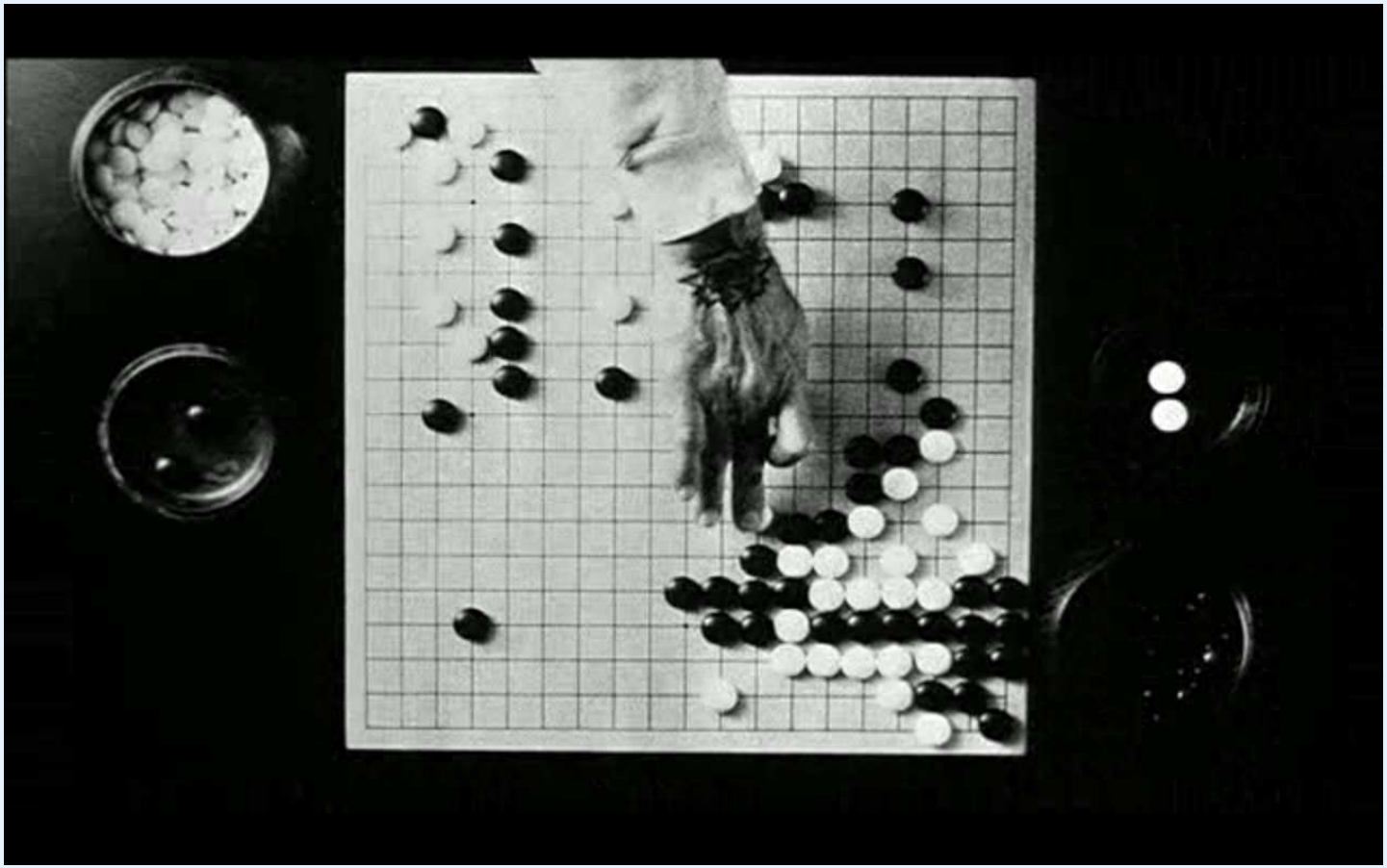
3.14159265358979323846264338327950288419716939937510582097494459230781640628620899862803482534211706798214808651328230664709384460955058223172535940812848111745028410270193852110555964462294895493038196442881097566593344612847564823378678316527120190914564856692346034861045432664821339360726024914127372458700660631558817488152092096282925409171536436789259036001133053054882046652138414695194151160943305727036575959195309218611738193261179310511854807446237996274956735188575272489122793818301194912983367336244065664308602139494639522473719070217986094370277053921717629317675238467481846766940513200056812714526356082778577134275778960917363717872146844090122495343014654...

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?

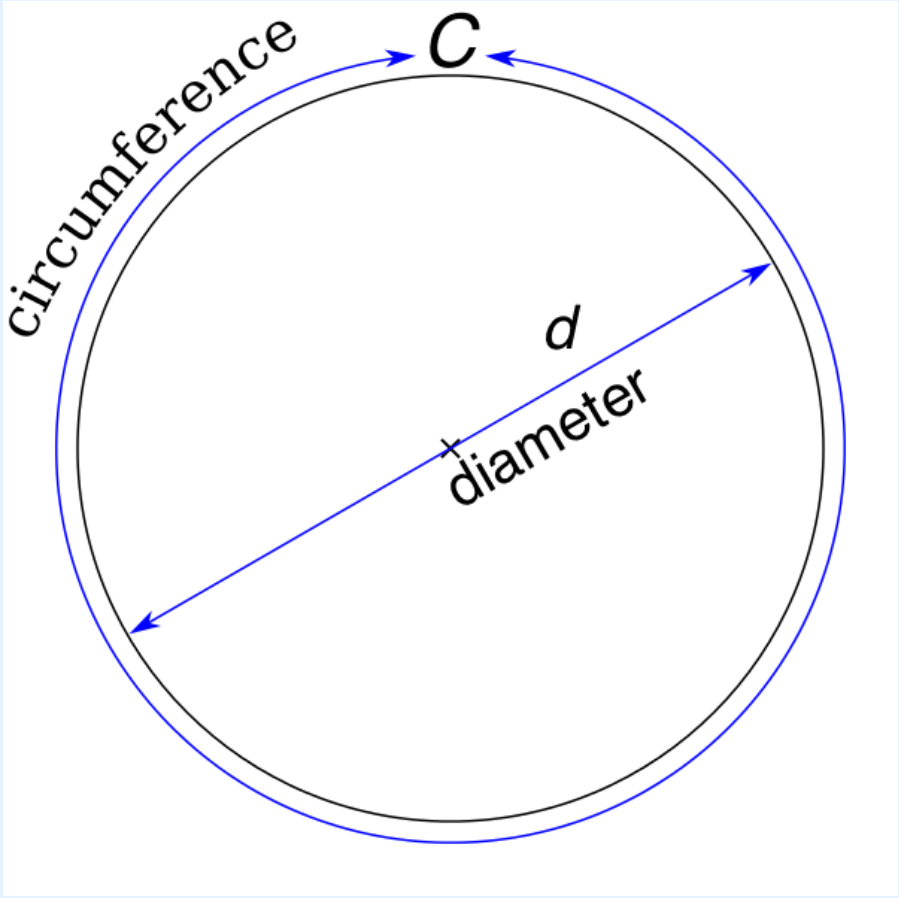
Or maybe that's just crazy?

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

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

```
1  Math::PI
2  => 3.141592653589793
3  Math.sin Math::PI
4  => 1.2246467991473532e-16
5  Math.cos Math::PI
6  => -1.0
7  Math.tan Math::PI
8  => -1.2246467991473532e-16
9  2 * Math.asin(1)
10 => 3.141592653589793
11 Math.acos -1
12 => 3.141592653589793
```

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



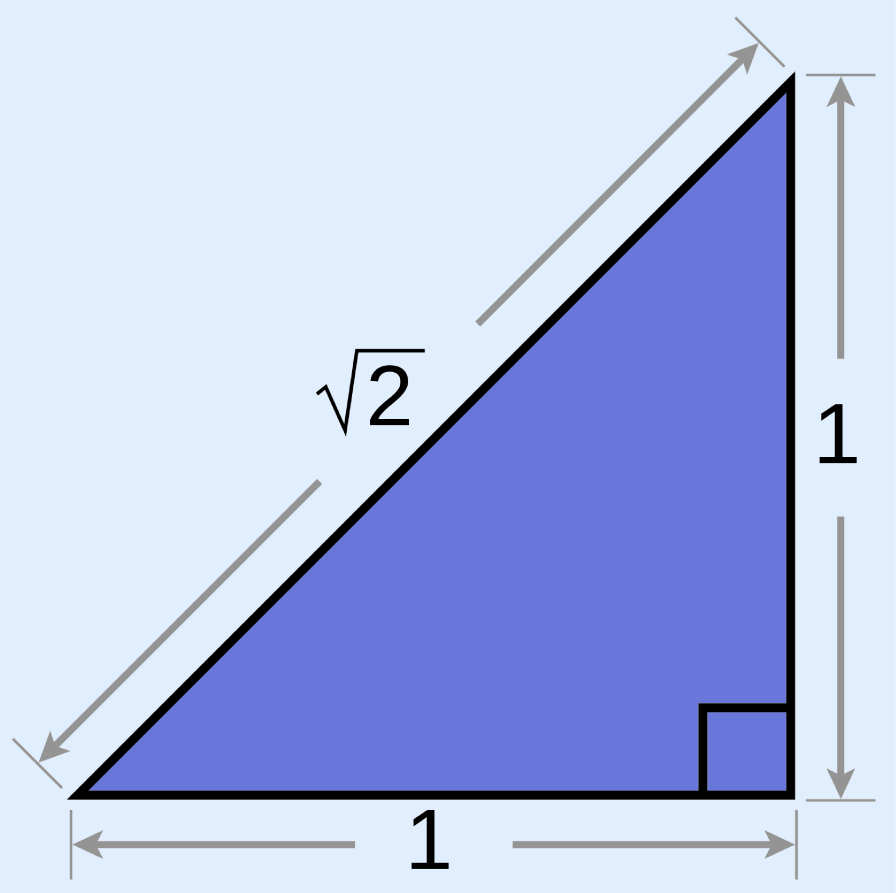
π is an irrational number.

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

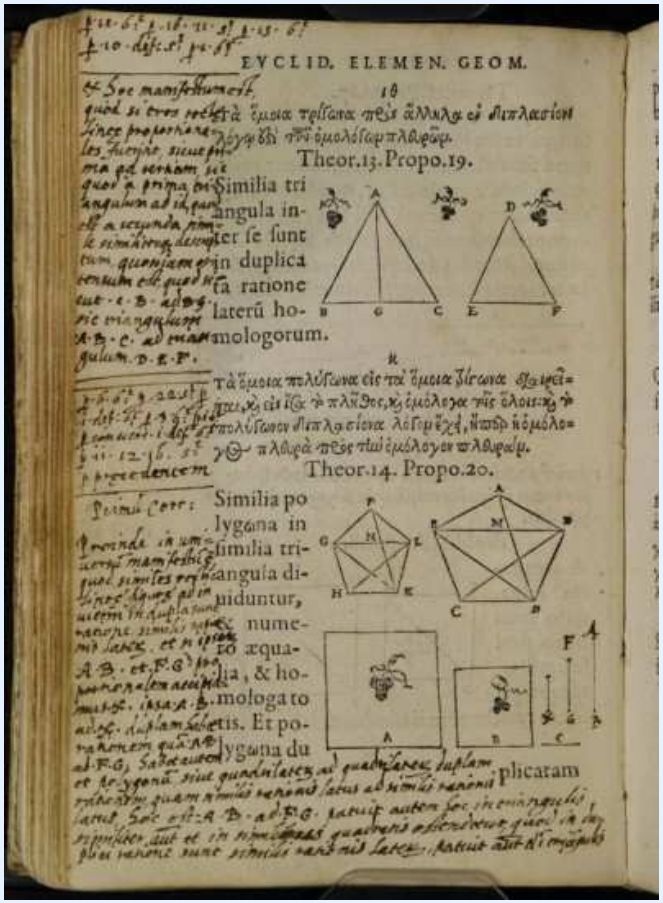
Hippasus of Metapontum, founder of the Mathematikoi school of the Pythagoreans, proved it *(probably.)*

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.


EVCLID. ELEMEN. GEOM.

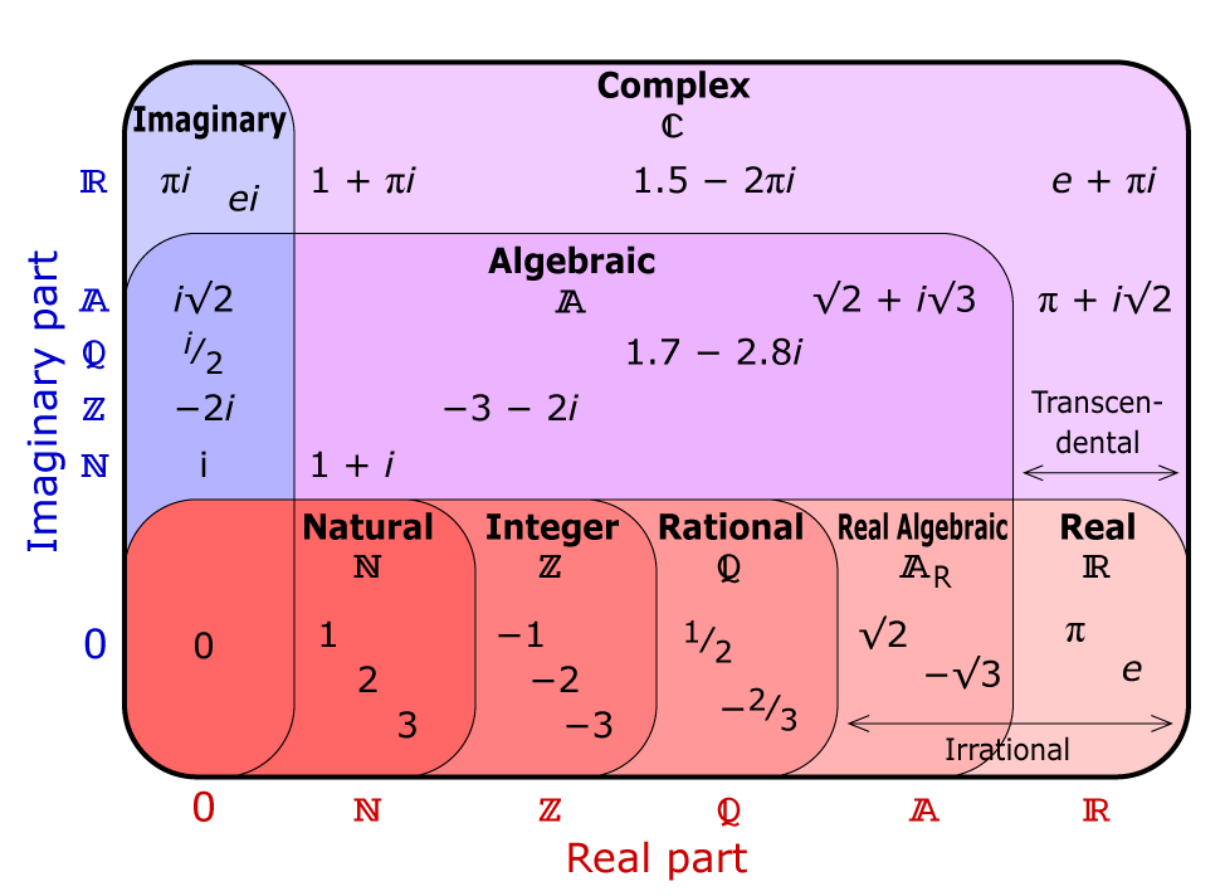
Theor.13.Propo.19.

Similia trianguła inter ſe ſunt in duplicata ratione laterũ homologorum.

Theor.14. Propo.20.

Similia polygona in ſimilia triangula diuiduntur, & numero æqualia, & homologa totis. Et polygonum duplicaram

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



Let's calculate π!

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

```
1  def gimme_pi(n)
2    num, den = 4.0, 1
3    pi = 0
4    plus = true
5    while den < n
6      if plus
7        pi = pi + num/den
8      else
9        pi = pi - num/den
10     end
11     plus = not plus
12     den = den + 2
13   end
14   pi
15 end
```

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

```
gimme_pi 1
# => 0
gimme_pi 10
# => 3.339682539682540 3
gimme_pi 100
# => 3.121594652591011
gimme_pi 1_000
# => 3.139592655589785
gimme_pi 10_000
# => 3.141392653591791
gimme_pi 100_000
# => 3.141572653589781 4
gimme_pi 1_000_000
# => 3.141590653589692
gimme_pi 10_000_000
# => 3.141592453589779 7
gimme_pi 100_000_000
# => 3.141592633590250 6
```

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

$$e^{i\pi} + 1 = 0$$

Questions?