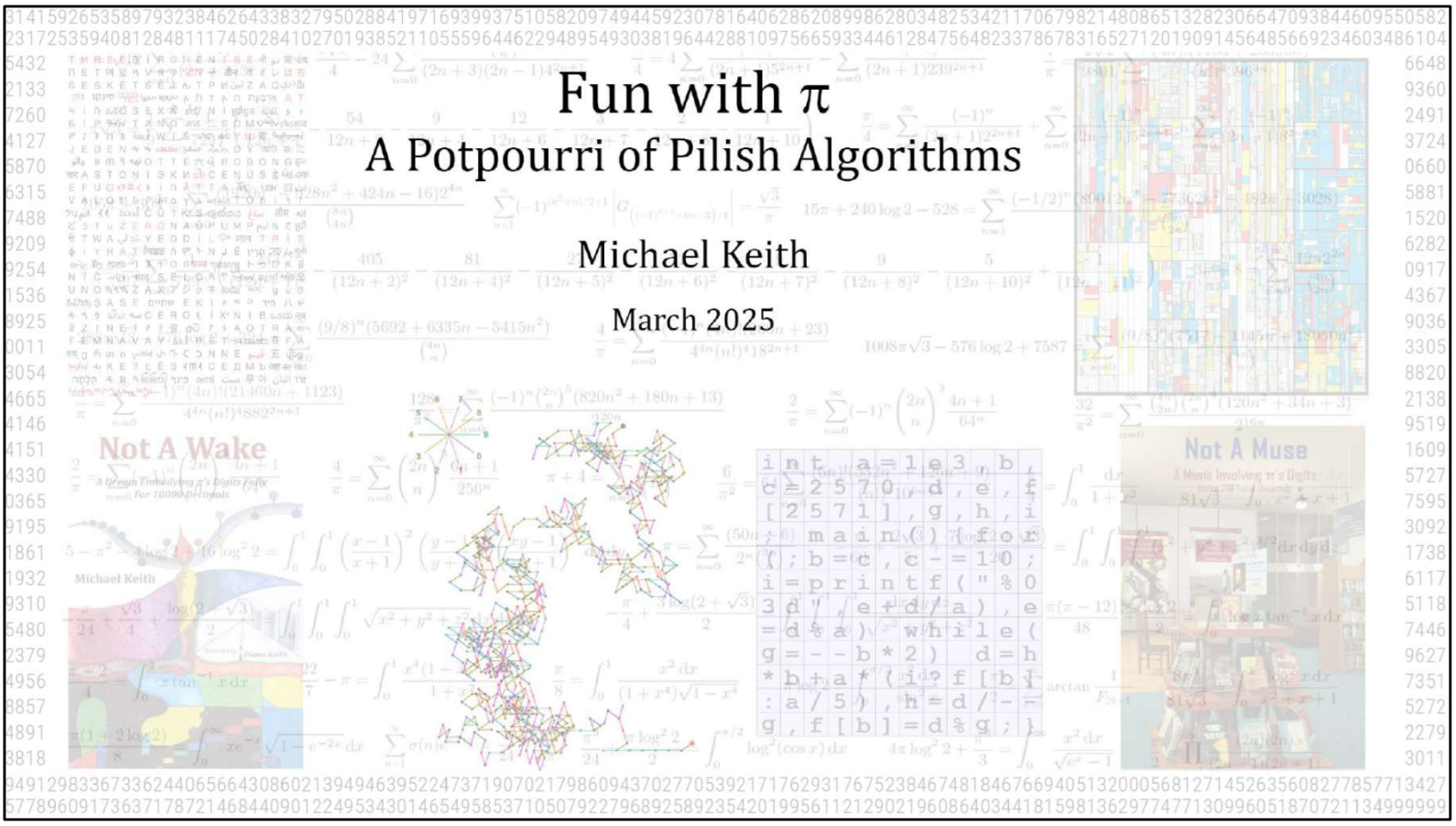
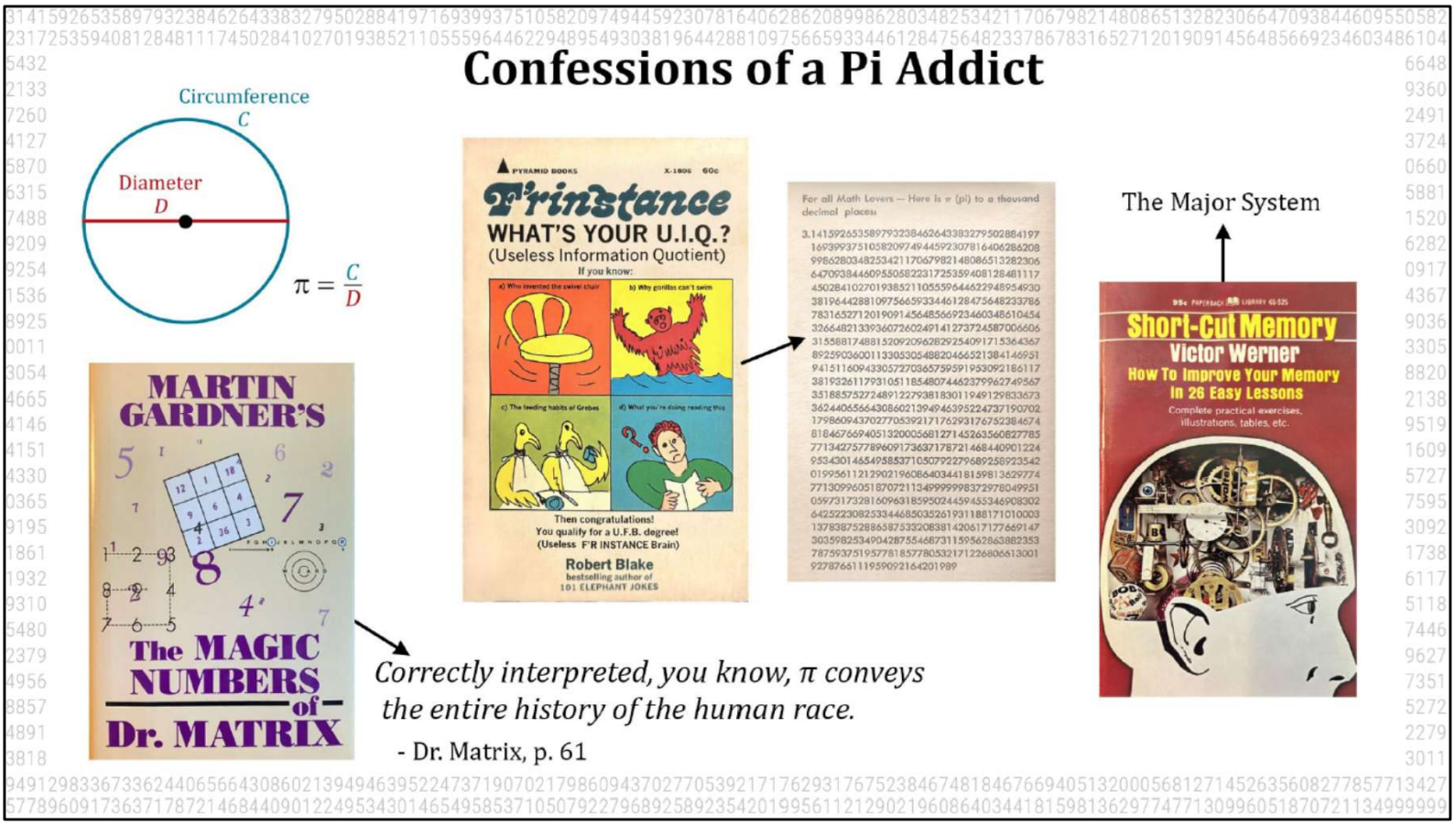
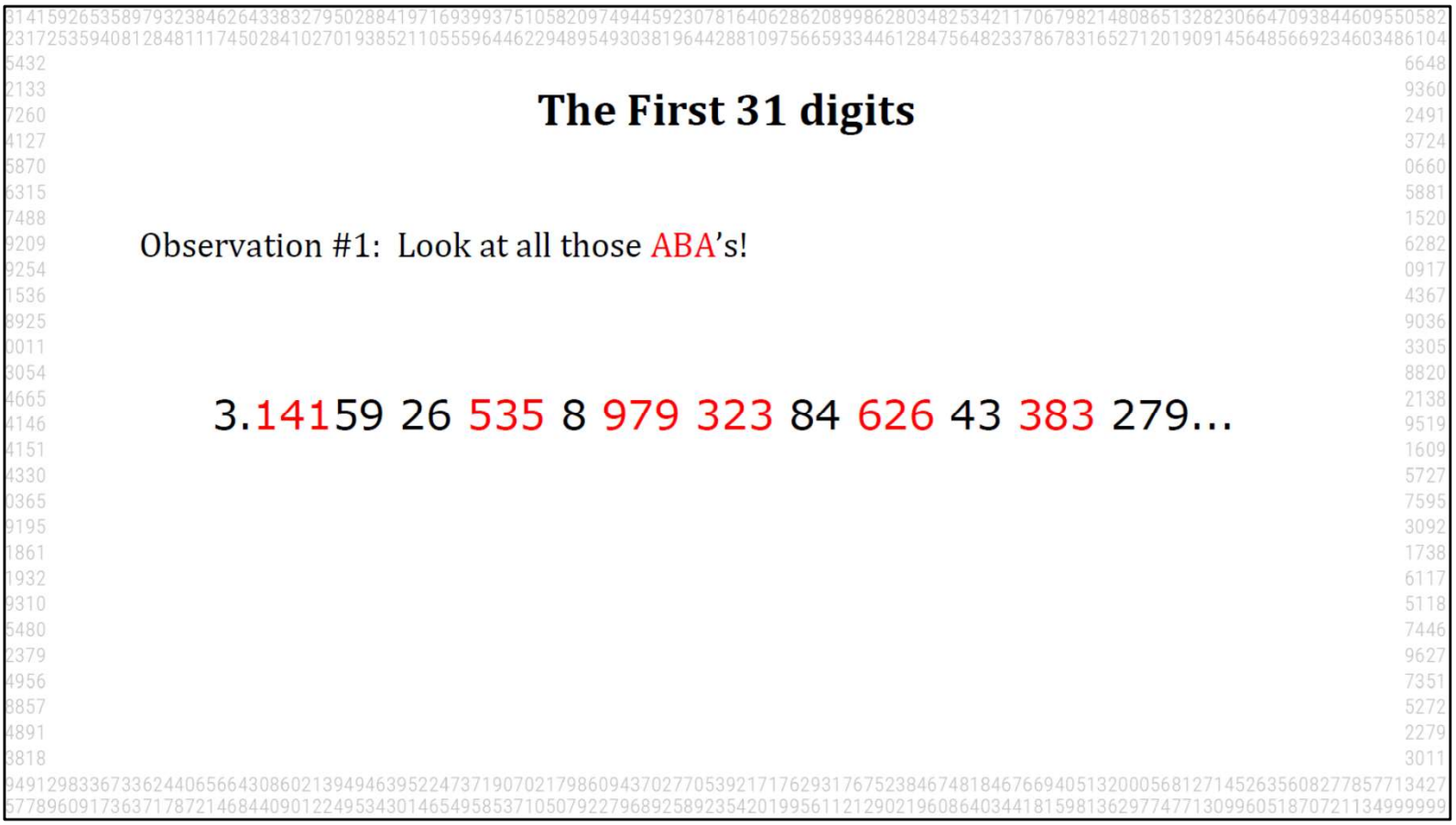


Fun with Pi: A Potourri of Pilish Algorithms

Presented at Princeton Chapter of ACM – March 20, 2025.



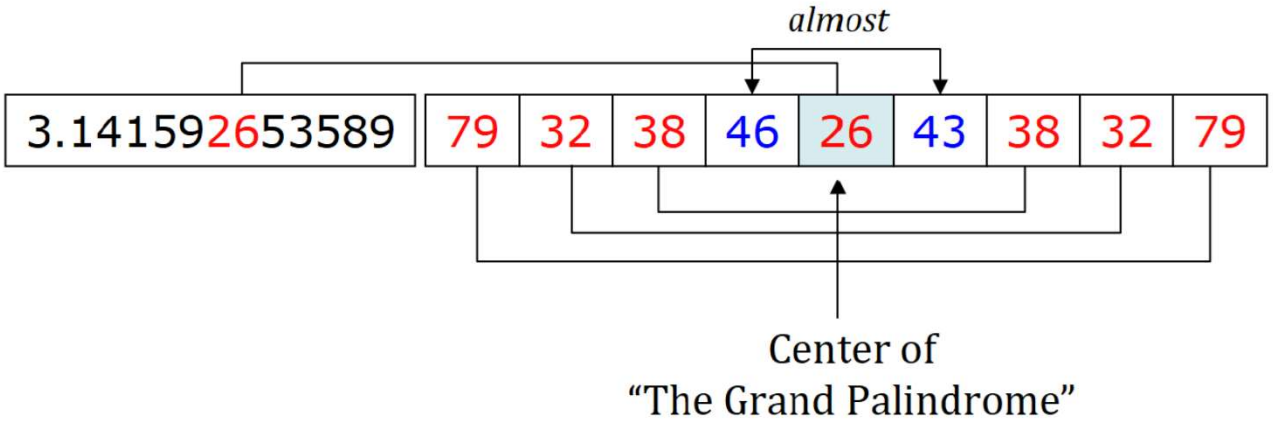
Slide 2: This talk is somewhat personal as well as technical. These three books from my childhood were directly responsible for starting my life-long interest in the number π. Martin Gardner's columns in *Scientific American* were an inspiration in general, but especially the ones featuring his fictional "Dr. Matrix", which tended to be extra fun and sometimes involved π. In the middle is a book of humorous trivia that happened to be the first place I saw many digits of π (there are 1001 there). The book on the right piqued my interest in memorizing the digits of π – which we'll talk more about later.



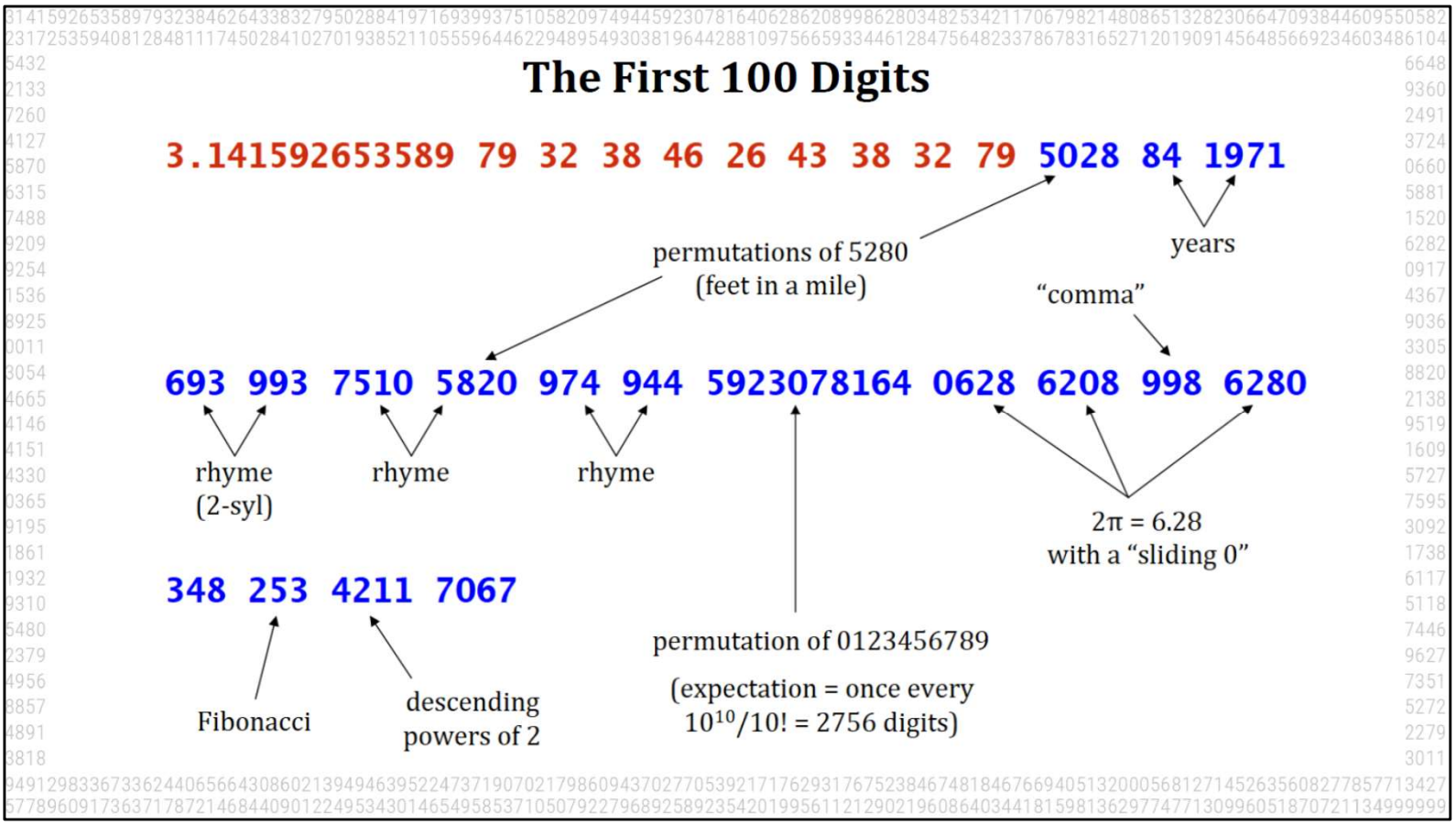
Slide 3: Here (and on the next slide) are two interesting features of the first 31 digits. The probability of an ABA pattern (in random digits) is 1/10, so in 30 digits we'd expect to see 3 ABAs on average, but there are 6 of them. It's a catchy pattern to say so it helps in memorizing these initial digits.

The First 31 digits

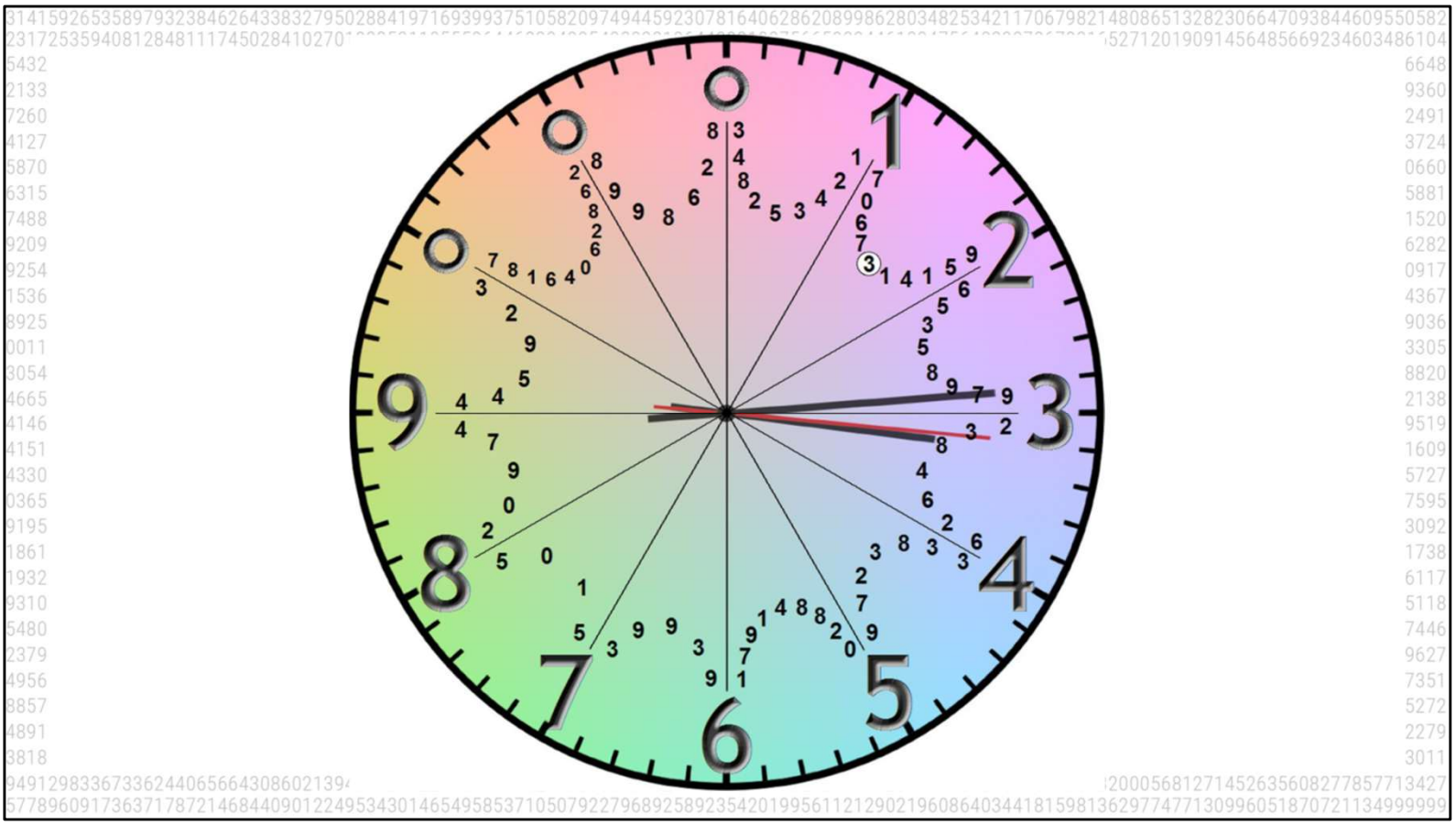
Observation #2: from Martin Gardner's "Dr. Matrix":



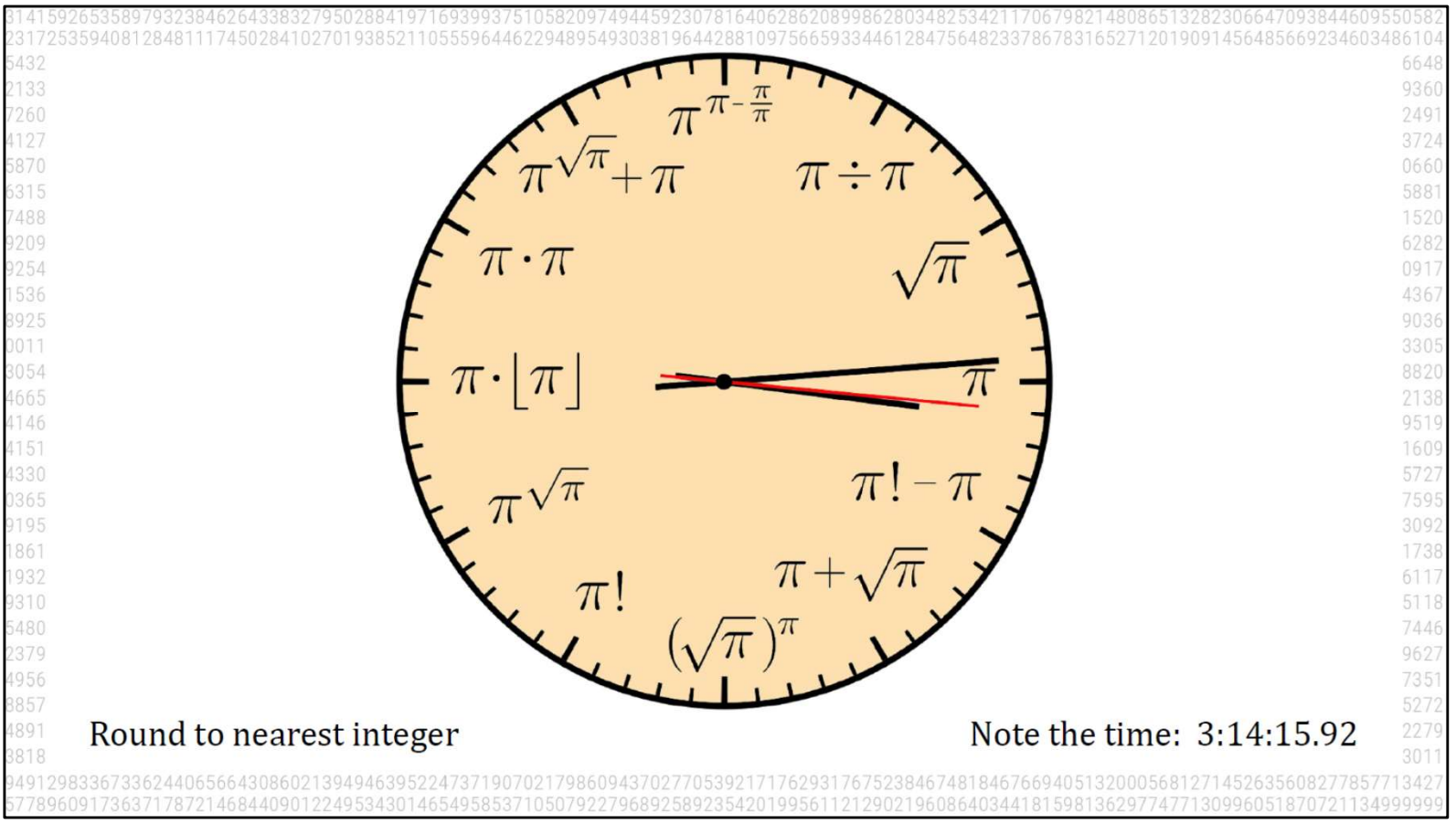
Slide 4: Another way to look at these was pointed out by M. Gardner. After the 3.141592653589 is a series of 18 digits which, in pairs, is nearly a palindrome. It's exact except for 46/43, which are almost a match. Note that the 26 in the middle of the palindrome harkens back to the earlier 26.



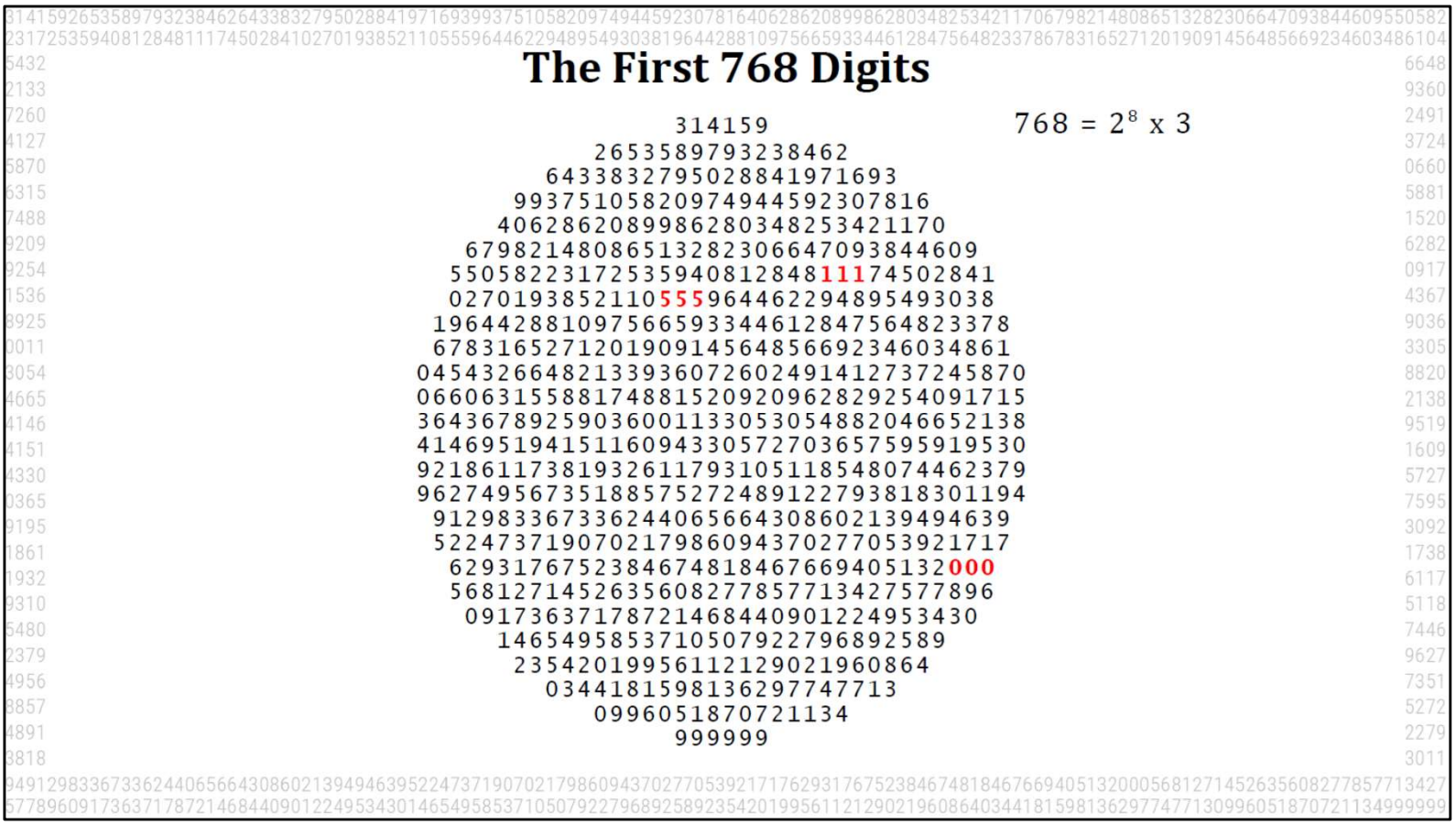
Slide 5: Even the first 100 digits have enough interesting patterns to be fairly easy to memorize. The annotations show some of allusions I use to help remember them.



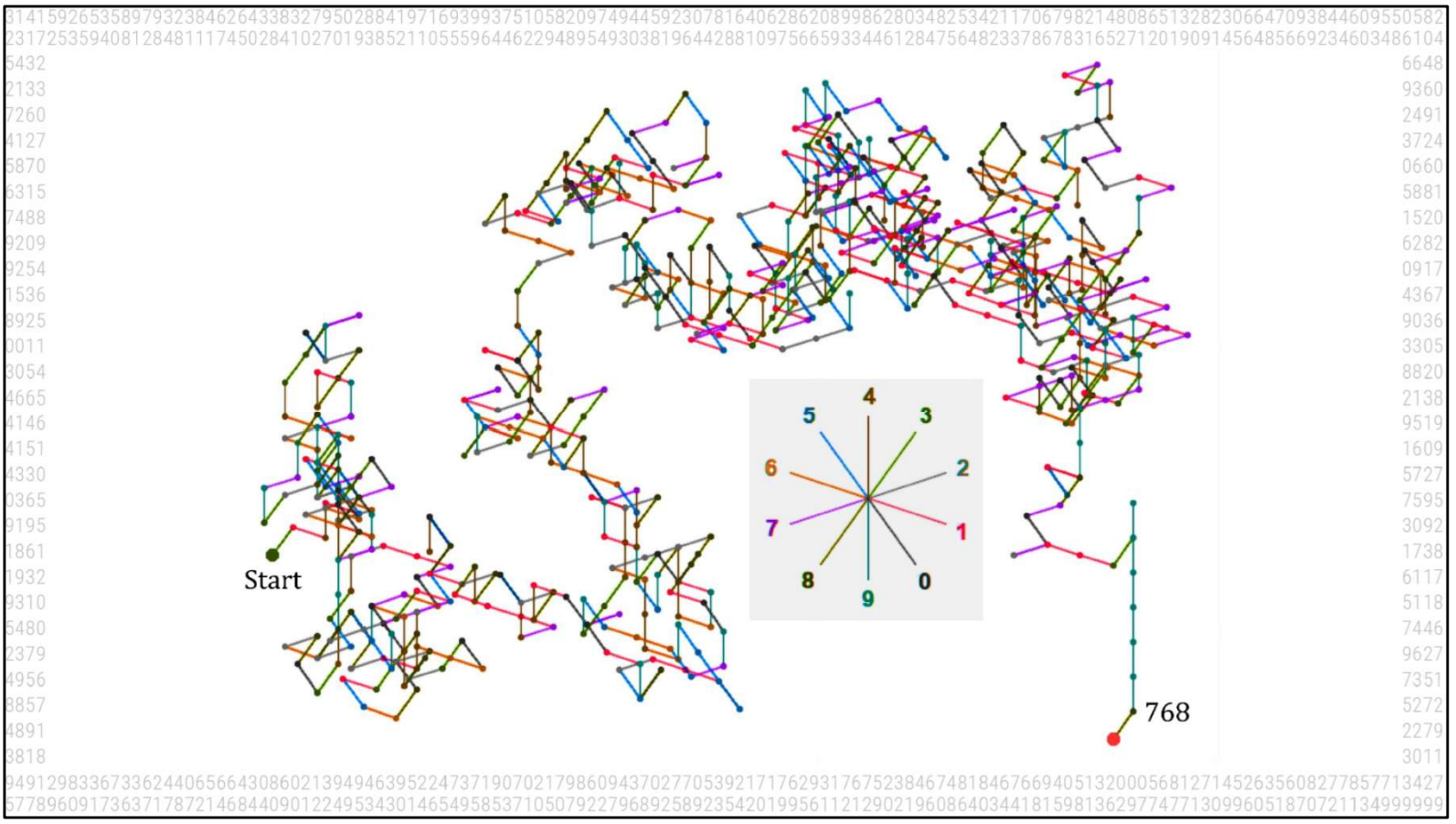
Slide 6: A little sidebar. It's fun and interesting to make graphic designs based on the digits of π. One that I created is this clock face in which the first 100 digits appear in order around the clock (starting at the white circled 3) AND correctly include the big hour digits into the sequence. The only trick needed is to denote the hour numbers 10, 11, 12 with a circle, which represent a digit 0 in the sequence.



Slide 7: Speaking of clocks, here's one where the 1-to-12 hour numbers are represented using only the number π. (You have to implicitly round each to the nearest integer.) Another nice observation is that at "π time" on a clock (that is, 3:14:15.92) all three hands fit in a very small angle.



Slide 8: One of the most well-known and remarkable things in π's digits is the 999999 that appears at digits 763 to 768 (see bottom line of the disc of digits). There are three "runs" of three equal digits in this range (shown in red), but no longer runs other than the 999999. This is clearly surprising, but how much?



Slide 9: Another “graphic design” sidebar. We make a “walk” diagram (like a random walk, but using the digits of π to drive it) with 10 different walk directions, one for each digit value. Of course the 999999 is very obvious at the lower right (I’ve also included the 8 that’s just after the 999999).

Probability of a run: an exact formula

Let $\rho(n,r,b)$ = probability that a "run" of equal digits (of length r) starts within the first n digits after the radix point of a random base-b real number. Then:

$$\rho(n, r, b) = P(n + r - 2,\ r - 1,\ \frac{1}{b})$$

$$\text{where} \quad P(n, r, p) = \ 1 - A(n,\ r,\ p) \ + \ p^r A(n - r,\ r,\ p)$$

$$\text{and} \quad A(n, r, p) = \sum_{k=0}^{\lfloor n/(r+1) \rfloor} (-1)^k \binom{n - kr}{k} ((1 - p)p^r)^k$$

$P(n,r,p)$ is the probability of a run of r successes in n trials, where the probability of success on each trial is p.

[see Villarino, *The probability of a run*, Math. Gazette, Mar. 2007]

Slide 10: Let's do a deep dive into the 999999. We'd like to know how unlikely it really is for this to appear in the first 768 digits, and would also like to know: is there another run of equal digits later in π that's even more remarkable? To quantify this, note that π's digits look like statistically independent uniform random digits. So to answer "how remarkable is some pattern in π?" we can ask "what's the probability of that pattern occurring in a uniformly random string of digits?". One can answer this roughly using approximations, but amazingly there's an exact formula, shown here.

Other runs vs. the 999999

- Denote by N the benchmark probability of the 999999,
  a run of length 6 starting within the first 762 digits after the decimal point:

$$N = \rho(762, 6, 10) = 0.0068358667\ldots \approx \mathbf{1/146}$$

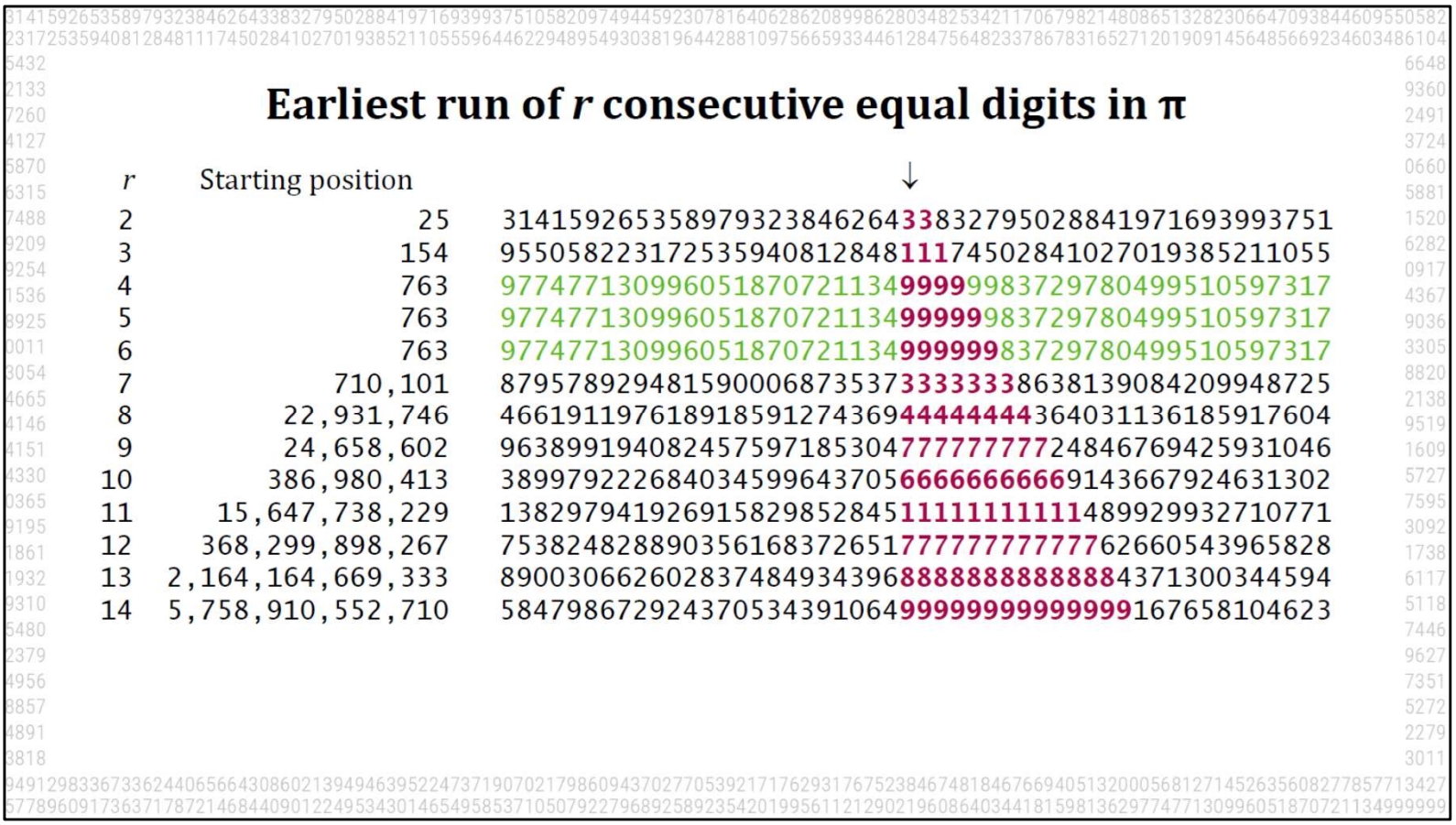
- The relative rarity of some other (n, r, b) run is

$$R = \frac{N}{\rho(n, r, b)}.$$

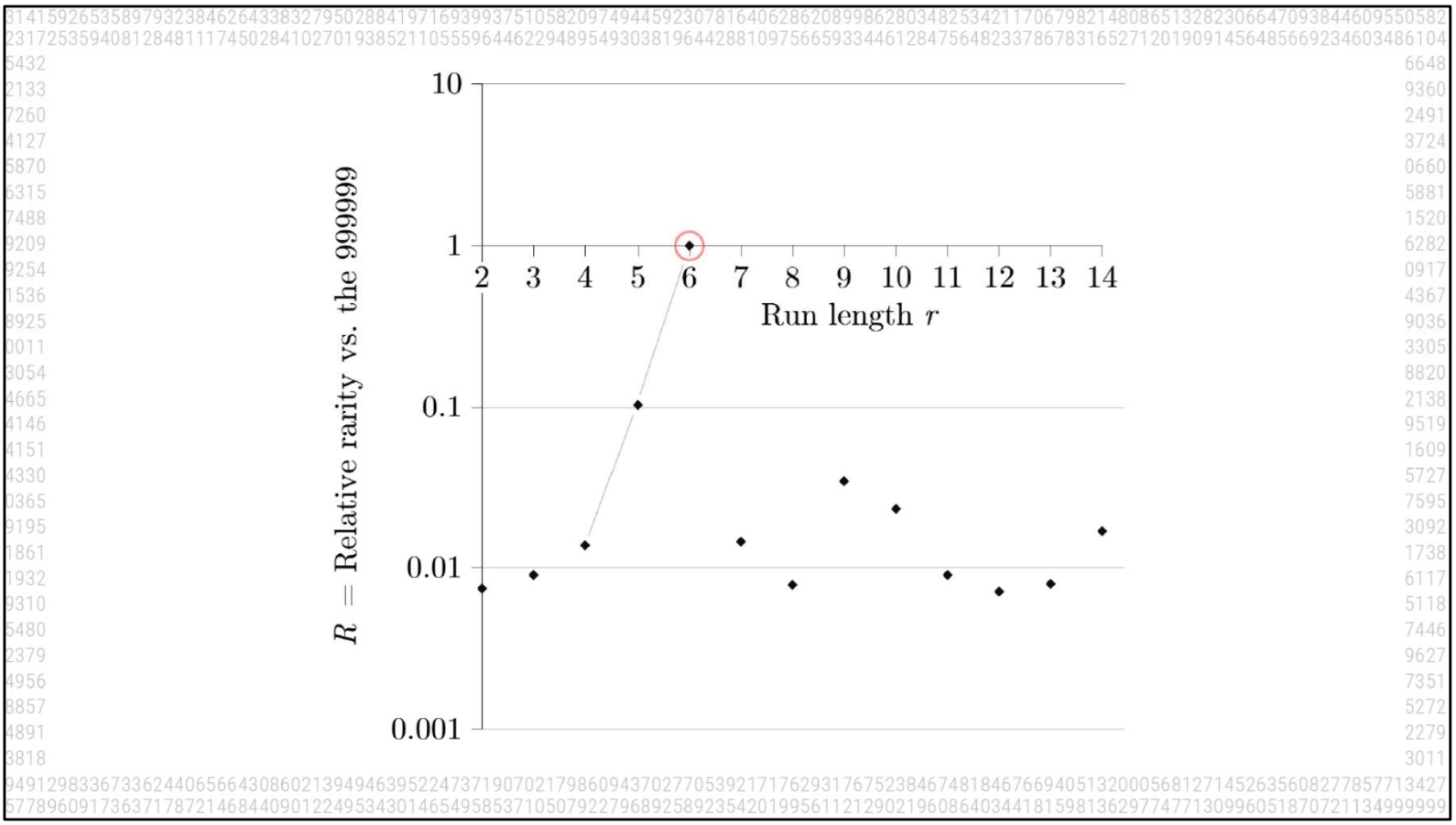
- A run is more remarkable than the 999999 if

$$R > 1$$

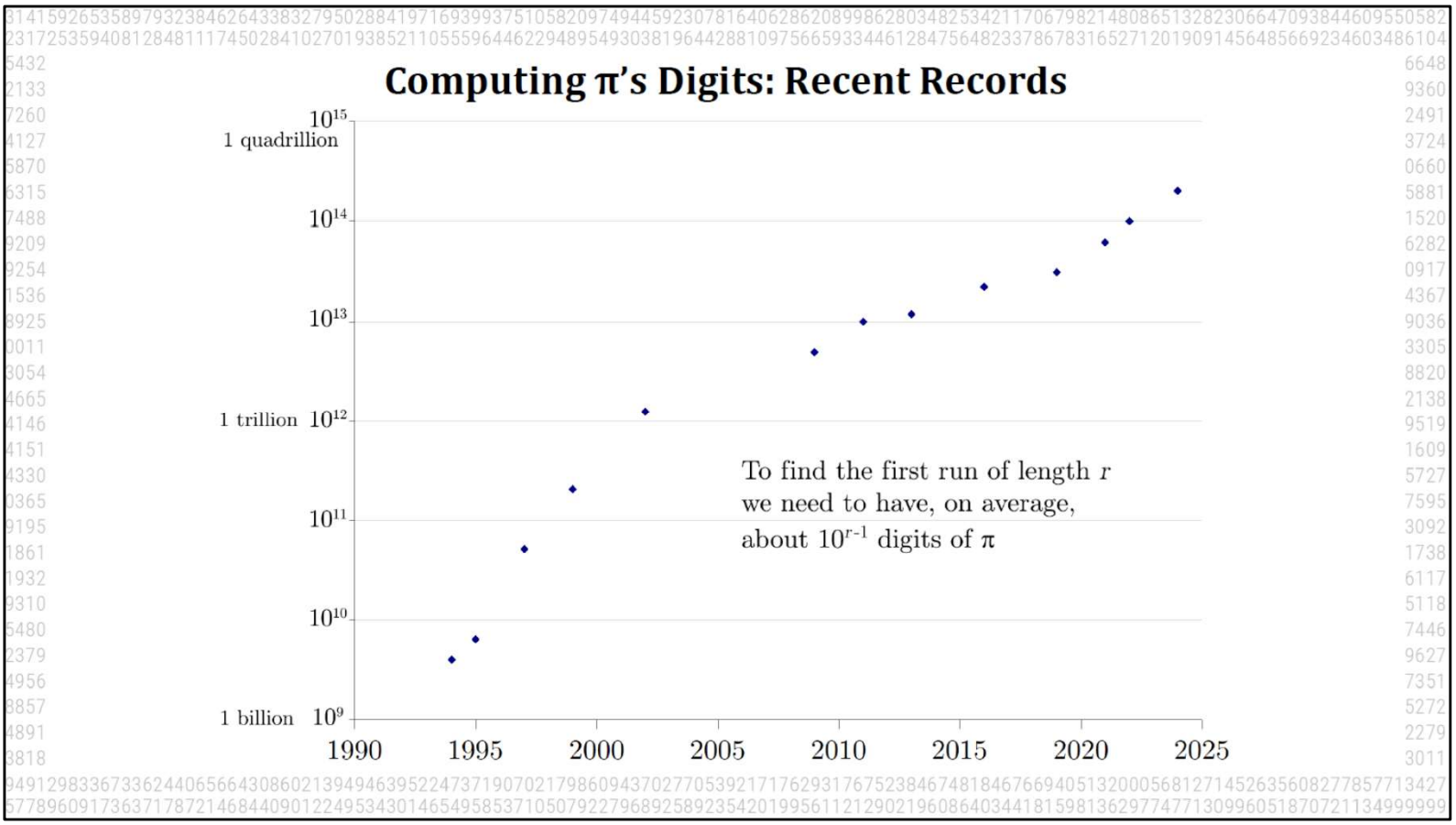
Slide 11: Using that formula we find that the probability of six identical digits in a row (doesn't matter what the actual digit is) appearing somewhere in the first 768 digits is N ≈ 1/146, which matches our intuition – it's quite unlikely. Define R as the relative probability of some other run compared to N. We seek another run with R > 1.



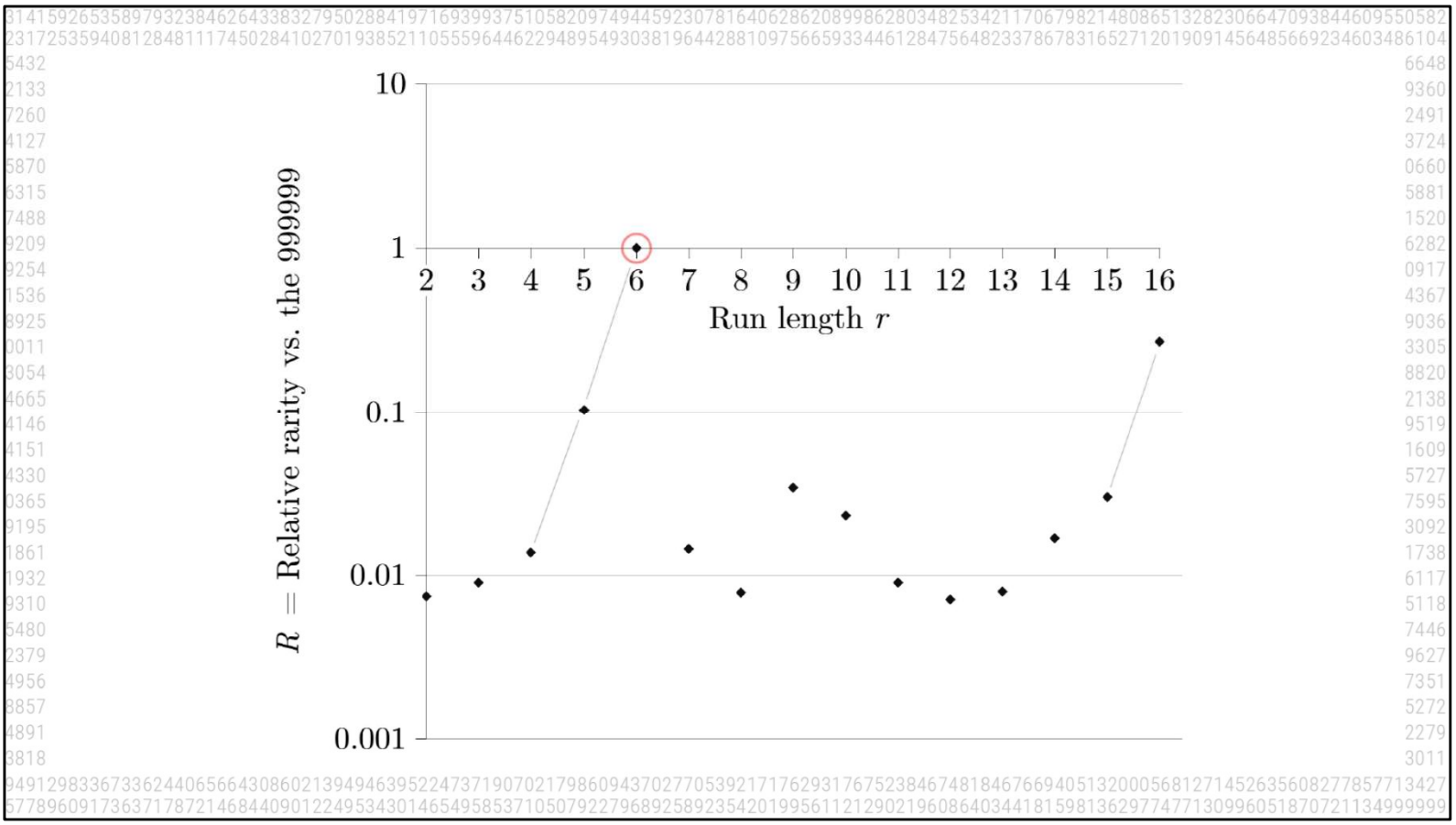
Slide 12: Here are the first runs of length *r* from *r* = 2 to 14. Note that the 999999 is simultaneously the first run of length 4, 5, and 6, and this kind of thing does not occur again up to *r* = 14.



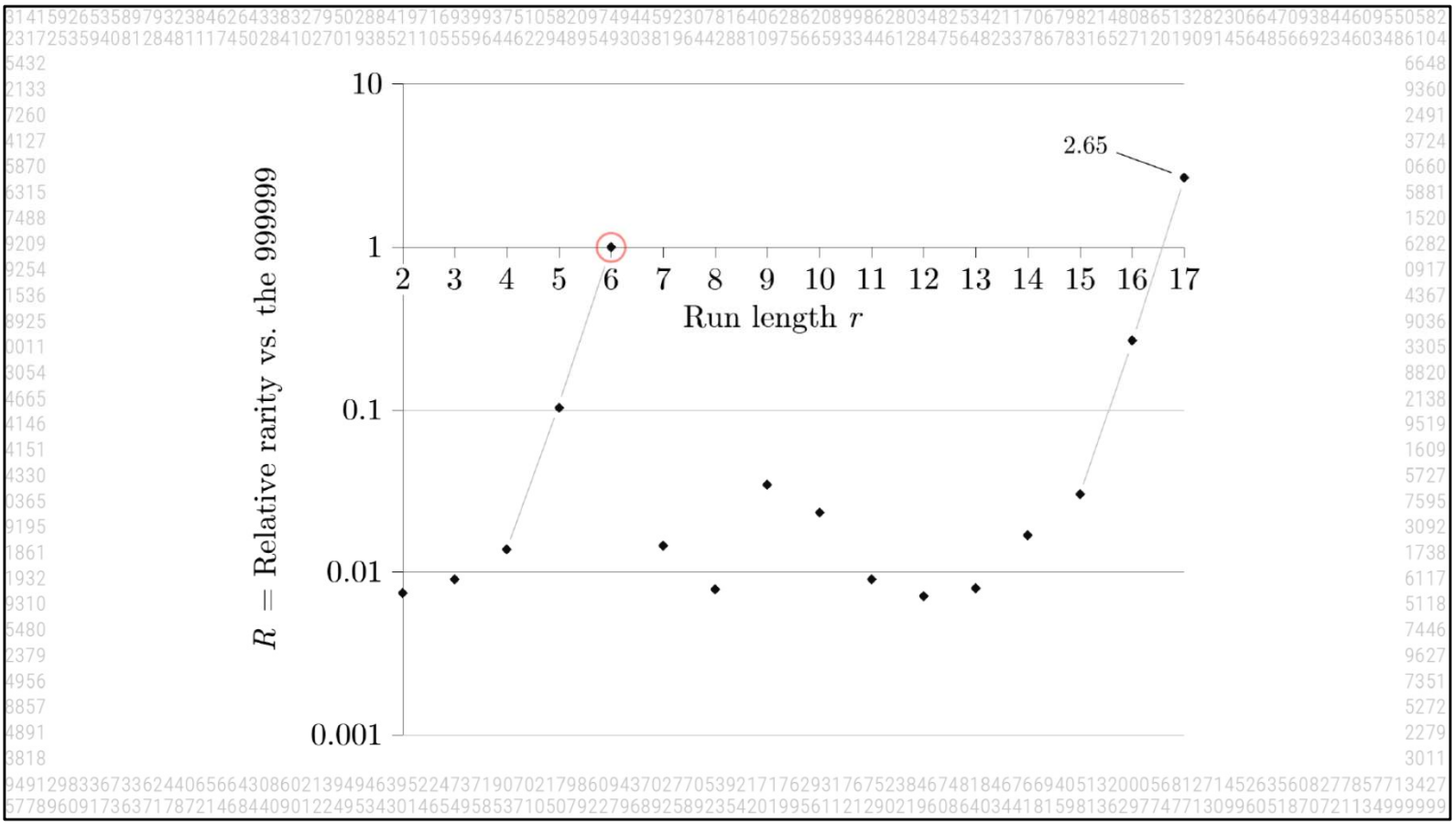
Slide 13: Here are the actual values of R for those runs (note that vertical scale is logarithmic). As you can see, there aren't any with R > 1.



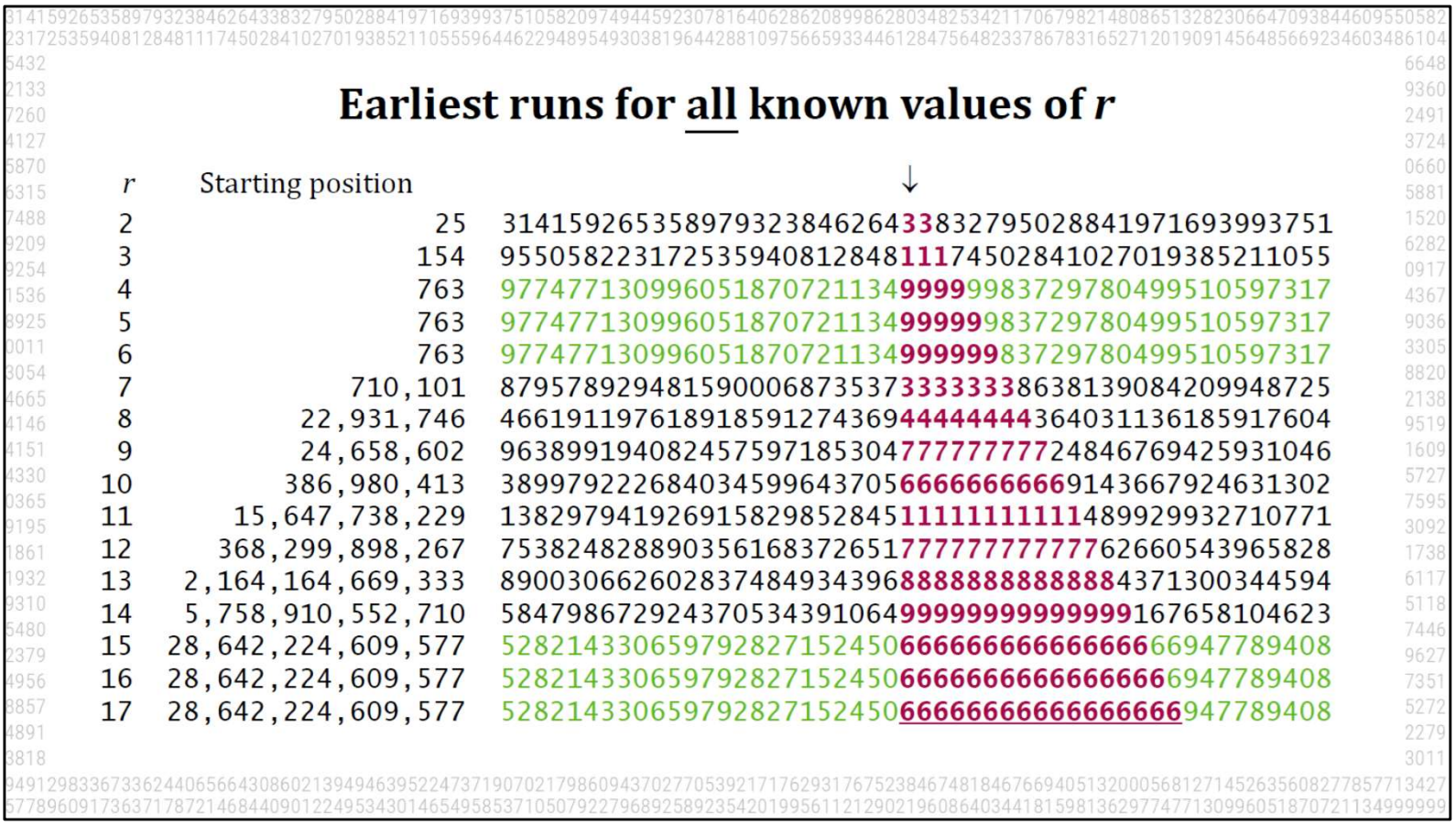
Slide 14: Sidebar: how many digits of π do we currently know? This shows the answer – the current record computation is 202 trillion digits, from June 2024. We can see from this that the graph on the previous page is getting close to the point (though not quite there) when we'll run out of known digits.



Slide 15: BUT…guess what, we do know a few more data points – here we've added the next two. Note that they start another set of "embedded" runs like the r = 4,5,6 set. If only there was one more in the set we would get one with R > 1…



Slide 16: Yes! Unbelievably, there is one more in the set, with the first runs of length 15, 16, and 17 all occurring at the same place, and the r = 17 run has R > 1! Specifically, it's R = 2.65. Note that r = 17 is the last one currently known – humans haven't computed enough digits of π to find any first run with r > 17.



Slide 17: Here are the actual digits for all the known first runs.

What About Other Bases?

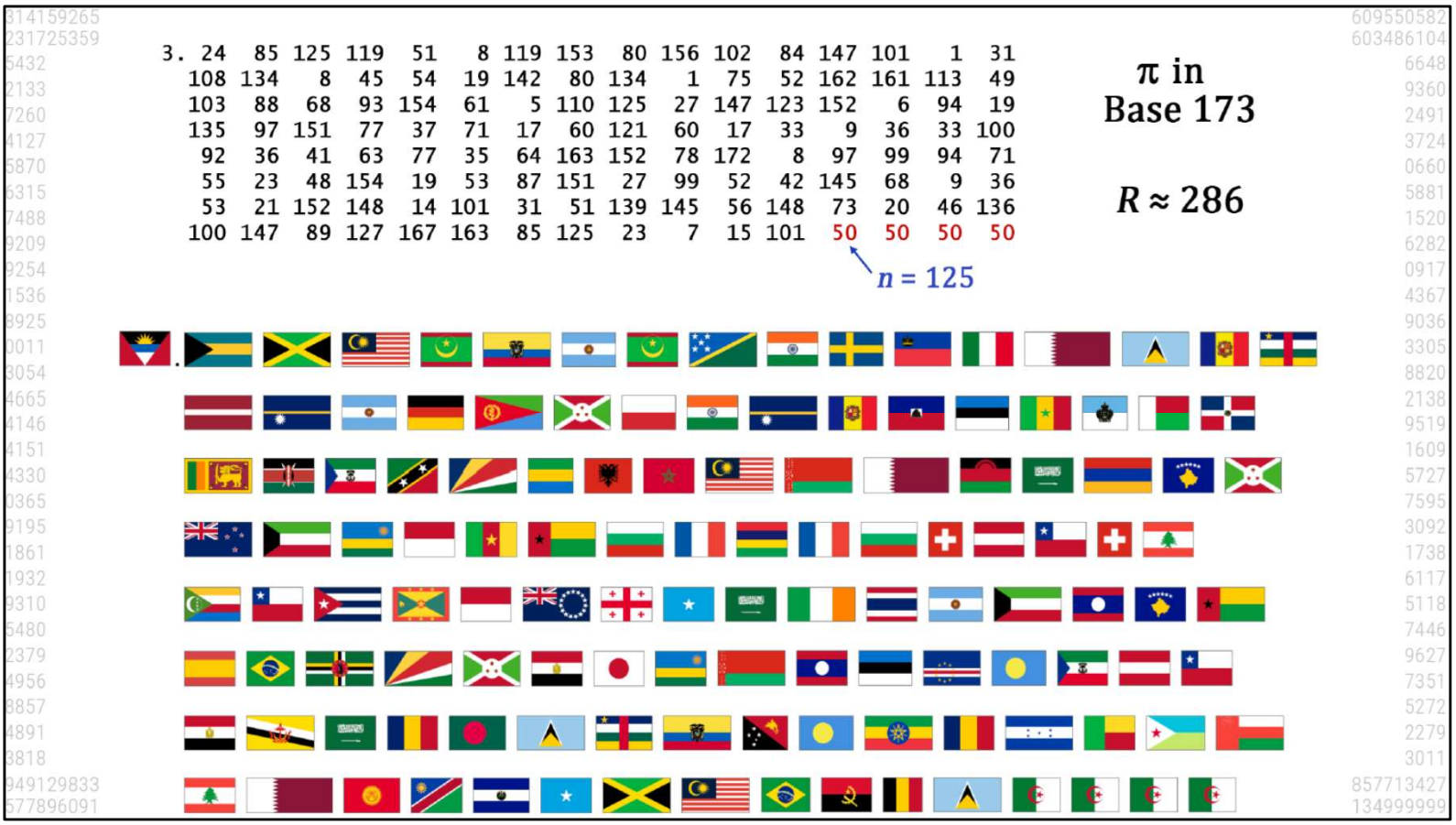
- Like any number, π can be written in other bases (not just base 10):
  - Base 10 uses digits 0 to 9
  - Base b uses digits 0 to b-1

Base 5:	3.	0	3	2	3	2	2	1	4	3	0	3	3	4	3	2	4	1	1	2	4
Base 6:	3.	0	5	0	3	3	0	0	5	1	4	1	5	1	2	4	1	0	5	2	3
Base 7:	3.	0	6	6	3	6	5	1	4	3	2	0	3	6	1	3	4	1	1	0	2
Base 8:	3.	1	1	0	3	7	5	5	2	4	2	1	0	2	6	4	3	0	2	1	5
Base 9:	3.	1	2	4	1	8	8	1	2	4	0	7	4	4	2	7	8	8	6	4	5
Base 10:	3.	1	4	1	5	9	2	6	5	3	5	8	9	7	9	3	2	3	8	4	6
Base 11:	3.	1	6	1	5	0	7	0	2	8	6	5	10	4	8	5	2	3	5	2	1
Base 12:	3.	1	8	4	8	0	9	4	9	3	11	9	1	8	6	6	4	5	7	3	10
Base 16:	3.	2	4	3	15	6	10	8	8	8	5	10	3	0	8	13	3	1	3	1	9
Base 28:	3.	3	27	0	6	21	18	24	19	25	21	27	10	7	7	4	7	11	12	24	13
Base 71:	3.	10	3	54	40	24	34	69	42	54	4	28	24	15	2	0	63	45	45	32	53

...

The 888 in base 16 has $R = 0.265\ldots \approx 1/4$

Slide 18: So we've completely explored base 10 for runs of equal digits, but what about other bases? Again remarkably, there's a fairly nice run in hexadecimal, since π in base 16 is 3.243F6A888..., which has the run 888 very early, at the 8th digit. This doesn't have R > 1, but its R value is about 1/4, which is quite respectable (only 4 times less remarkable than the 999999 in base 10).



Slide 19: Now we're talking! This run of four 50's at the 125th digit in base 173 has an R value of 286. Just for fun, I assigned each of the base-173 digits (0, 1, … 172) to a different country, giving the representation of π in base 173 shown at the bottom using country flags.

Base 209259756

π = 3.29629644 29629644 186455662 92370170 151764814

$R = 1{,}430{,}472$

Base

172749172525064743572978794572867385031953408343405274473402432993244554436507646934142353366228603814 8

π =

3.

24460013743264919944562599543591644644375480435458614723512005738128395346904651986120438502337769850 4

24460013743264919944562599543591644644375480435458614723512005738128395346904651986120438502337769850 4

91826185980693545700506134038987768155517746252881219808327495253990016667345026941521681089490865335 3

$R \approx 1.18 \times 10^{100}$ ← just over 1 googol!

***Conjecture*: 3.xx examples exist with arbitrarily large *R*.**

Slide 20: You think R=286 is good? – you ain't seen nothing. These two examples have a run (of length 2) immediately after the decimal point, which is the place where the R value is highest. The top one has R greater than 1 million while the second one has R greater than 1 googol! It is conjectured that an infinite number of examples like this exist, so there are examples with arbitrarily large R.

A Beautiful Formula

David and Gregory Chudnovsky (+ Ramanujan), 1988:

$$\pi = \left(12 \cdot \sum_{n=0}^{\infty} \frac{(-1)^n (6n)!}{(3n)!(n!)^3} \cdot \frac{13591409 + 545140134\,n}{640320^{3n+3/2}} \right)^{-1}$$

- Each term in the sum adds 14+ decimal digits

- For full speed: (1) Do the summation with "binary splitting"
  (2) Use fast integer multiplication (Schönhage-Strassen)

- With these, the complexity is $O(n \cdot (\log n)^3 \cdot \log\log n)$, where n = # of digits

- Has been used for almost all world-record π computations since ~1990

Slide 21: Change of topic: beautiful formulas or algorithms or approximations to π. The equation shown here is the basis of the Chudnovky Algorithm for computing the digits of π, which has been state-of-the-art since around 1990 (as no better algorithm has been found since then). It's interesting to note that the speed of the algorithm is now not the bottleneck when computing π – instead, the bottleneck is the speed and capacity of the SSDs used for mass storage during the computation.

A Beautiful Algorithm (in C language)

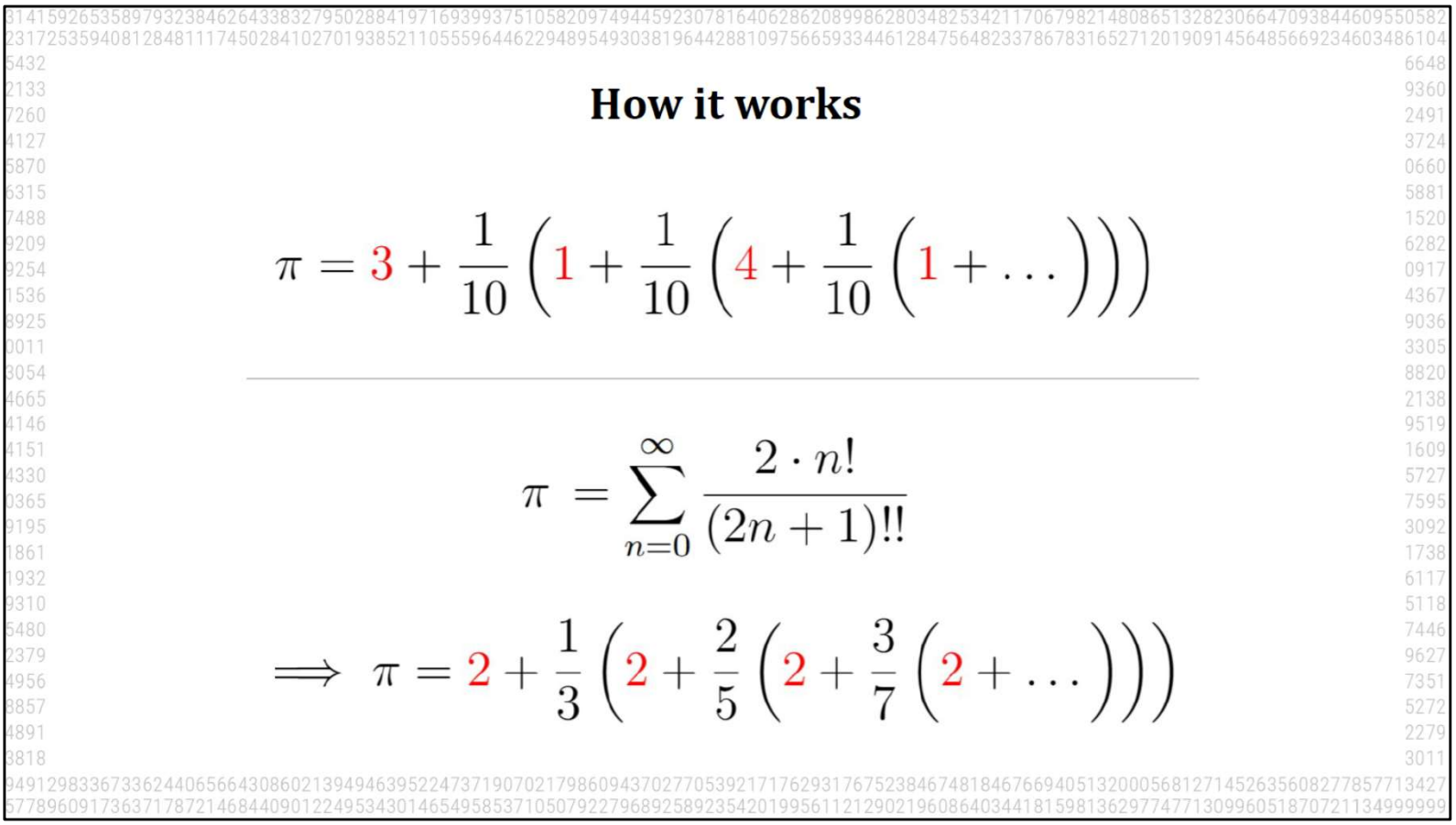
The Wagon/Rabinowitz Spigot (with the "predigit hack")

```
int main()  // Hard-coded for 768 digits
{
    int64_t accum = 0, prev = 0, length = 2592, stride = 27;
    int64_t a[2592], k, denom, digit, base = 1e8;

    for (k=1; k<=length; k++) a[k] = base/5;

    while (length > 0) {
      for (k = length-1; k >= 1; k--) {
        accum = accum * k  + (a[k] * base);
        denom = 2*k - 1;
        a[k] = accum % denom;
        accum = accum / denom;
      }
      digit = prev + accum/base;
      prev = accum % base;  accum = prev;
      length -= stride;
      printf("%08ld", digit);
    }
}
```

Complexity is $O(n^2)$

Can compute
100K digits
in ~15 seconds

Slide 22: This is a nice, and especially fun, algorithm for computing the digits that is very short and very simple. Note that it only requires one 64-bit integer array and seven 64-bit integer variables, and only 10 or so lines of code. For more info online, search for "spigot algorithm for π".



Slide 23: This is a brief summary of how it works. At the top is an expression of π as a nested summation showing that the digits (3 1 4 1…) are a representation of π in base 10 (because of the 1/10s). Below that, a known summation for pi can be transformed into an expression that's a mixed-radix representation of π, with bases 1/3, 2/5, 3/7, etc. Note that in this base π is simply 2.22222…! This explains why the code can be so simple – it's merely converting π from 2.222… in the mixed-radix base to base 10.

Some “code golfing” gives this tiny C version

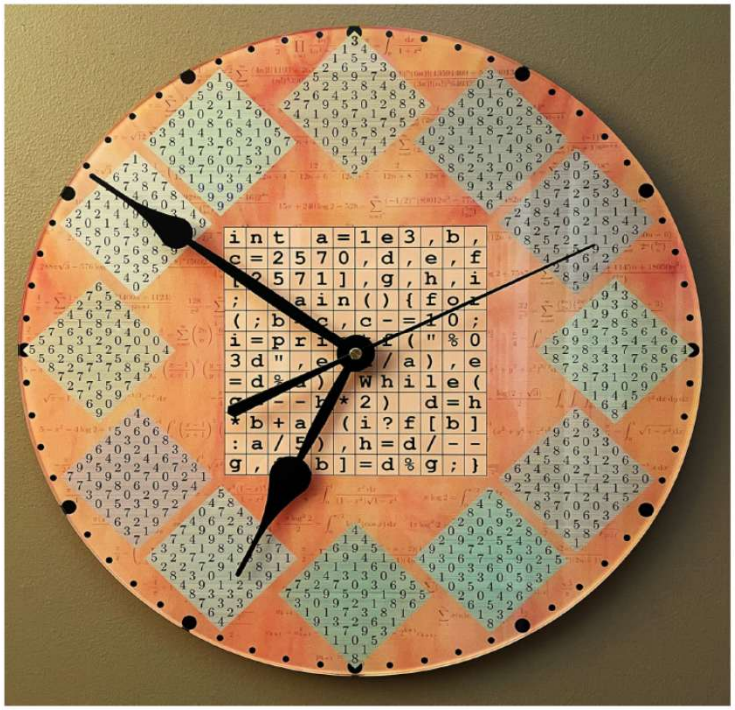
(by Dik T. Winter, Achim Flammenkamp, Christoph Haenel, and others)

(12 x 11) - 1 = 131

```
a[2702],b,c=
2702,d,f=1e4
,e,g,h;main(
){for(;b=c-=
14;h=printf(
"%04d",e+d/
f))f(e=d%=
f;g=--b*2;d/
=g)d=d*b+f*(
h?a[b]:f/5),
a[b]=d%--g;}
```

Slide 24: “Code golf” is the game of trying to reduce an algorithm’s source code to the smallest possible number of characters. In the C language, the code on slide 22 can be squeezed into 131 characters, which I have arranged here in a 12 x 11 rectangle with the gray square near the center not used.

A different version with **(12 x 12) – 3 = 141** characters



Slide 25: I used a different version of this code to make this actual physical clock. The 12 large diamonds serving as hour markers on the clock contain the program's output (768 digits = 12 sets of 64 digits).

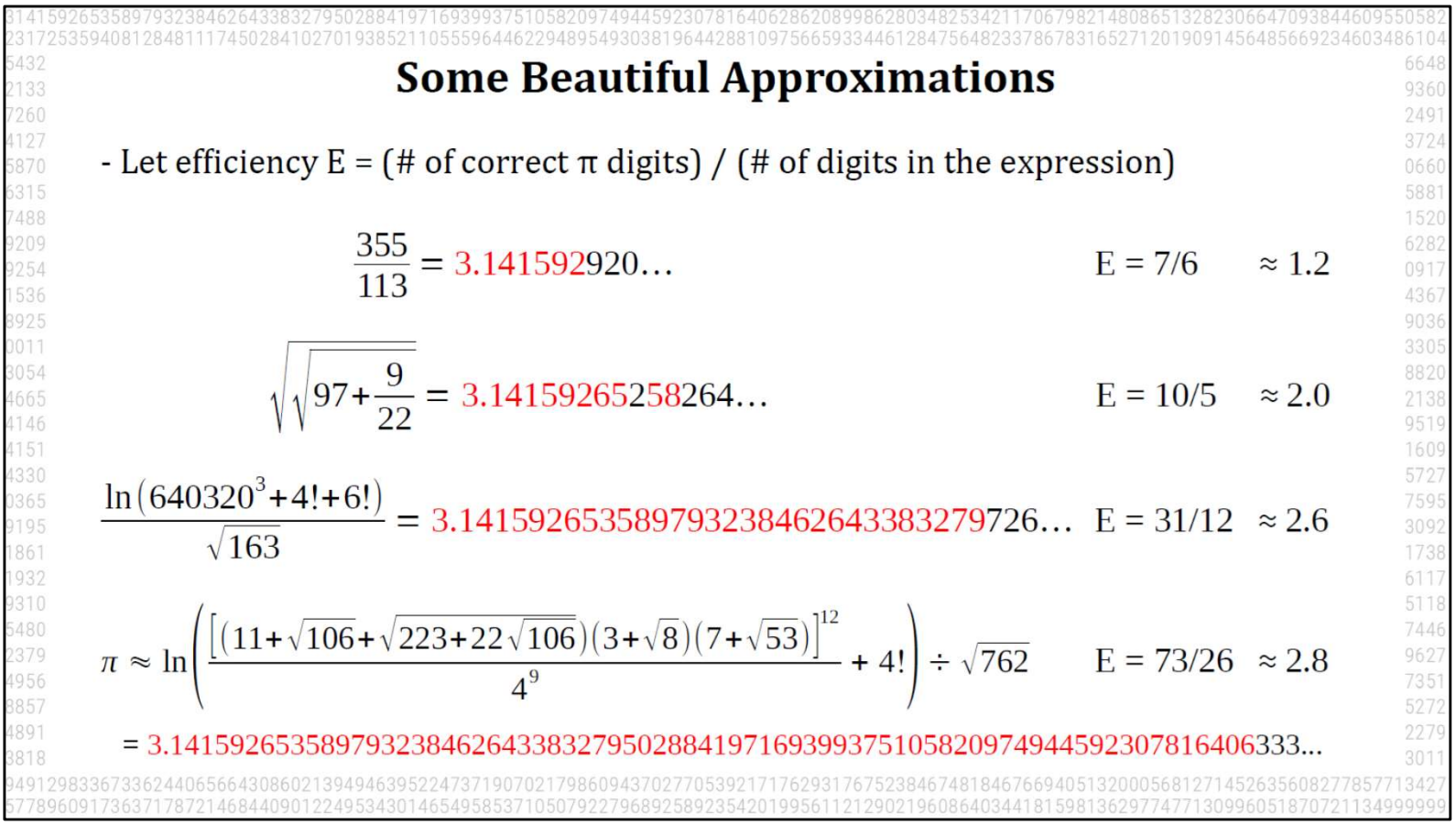
Heavy-meta π in LuaLaTeX

```
\documentclass[11pt]{article}
\usepackage[letterpaper]{geometry}
\usepackage{lmodern, luacode}
\begin{document} \Large \centering
Calculating $\pi$ using a \LaTeX
document (namely, this one!)
\par \bigskip \large \begin{luacode}
Q,o,oo,OO,O,Qo={},2688,0,0,0,1 for
Oo=0,o do Q[Oo]=2000 end for oO=o
,14,-14 do O=0 Oo=oO while(1)do
O=O+Q[Oo]*10000 oo=2*Oo-1 Q[Oo]=
O%oo O=O//oo Oo=Oo-1 if(Oo==0)then
break end O=O*Oo end tex.sprint(
string.format("%04d",OO+O//10000))
if Qo%16<1 then tex.print(" ")
end Qo=Qo+1 OO=O%10000 end
\end{luacode} \end{document}
```

Calculating π using a LaTeX document (namely, this one!)

31415926535897932384626433832795028841971693993751058209749445923078164062862089986280348253421170679821480865132823066470938446
09550582231725359408128481117450284102701938521105559644622948954930381964428810975665933446128475648233786783165271201909145648
56692346034861045432664821339360726024914127372458700660631558817
48815209209628292540917153643678925903600113305305488204665213841
46951941511609433057270365759591953092186117381932611793105118
54807446237996274956735188575272489122793818301194912983367336243
40656643086021394946395224737190702179860943702770539217176293176752384674818467669405132000568127145263560827785771342757896091
73637178721468440901224953430146549585371050792279689258923542019956112129021960864034418159813629774771309960518707211349999999

Slide 26: Another fun use for a short program like this is to compute π with the source code of a LaTeX document. The tiny code on the left (which is complete, valid LuaLaTeX source) produces the document at the right, in which the first 768 digits are computed by the process of compiling the document source.



Slide 27: Yet another fun recreation: find expressions containing numbers and math symbols that approximate the value of π, then "score" them by an efficiency metric that compares the number of correct digits in the approximation to the number of digits in the expression. Here are four examples with the desired feature of having E > 1. Every example but the first is based on the work of the Indian mathematician Srinivasa Ramanujan.

Pilish

- English with an added constraint:
  The number of letters in each word follows the digits of π.

"How I need a drink (alcoholic, of course)
3 1 4 1 5 9 2 3

after the heavy lectures involving quantum computing."
5 8 9 7 9 7 9

- Very much in the spirit of Oulipo, the (mostly) French literary group

Slide 28: New topic: the wonders of Pilish. As shown here, Pilish is English but with each word length following the sequence of π's digits. This example is an old classic that I've updated to be very modern by changing the word "mechanics" to "computing".

Piem #1

But a time I spent wandering in gloomy night,
  Yon tower, tinkling chimewise, loftily opportune;
Out, up, and together came twelve to Sunday rite,
  And one silently off to observe plenilune.

Joseph Shipley (1960) &
Michael Keith (later)

(31 digits)

Slide 29: Pilish can even be wrangled to handle additional constraints, such as here where we have a four-line poem with ABAB rhyme scheme. This is a joint composition by me and American writer Joseph Shipley. BTW, “plenilune” means “full moon”.

Piem #2

See a moon – a globe brilliant in flight –
Cross the great Jupiter's celestial ellipse;
Computers use pi – one constant they recite –
To create data now for tracking sun at eclipse.

Howard Bergerson (1965) &
Michael Keith (later)

(30 digits)

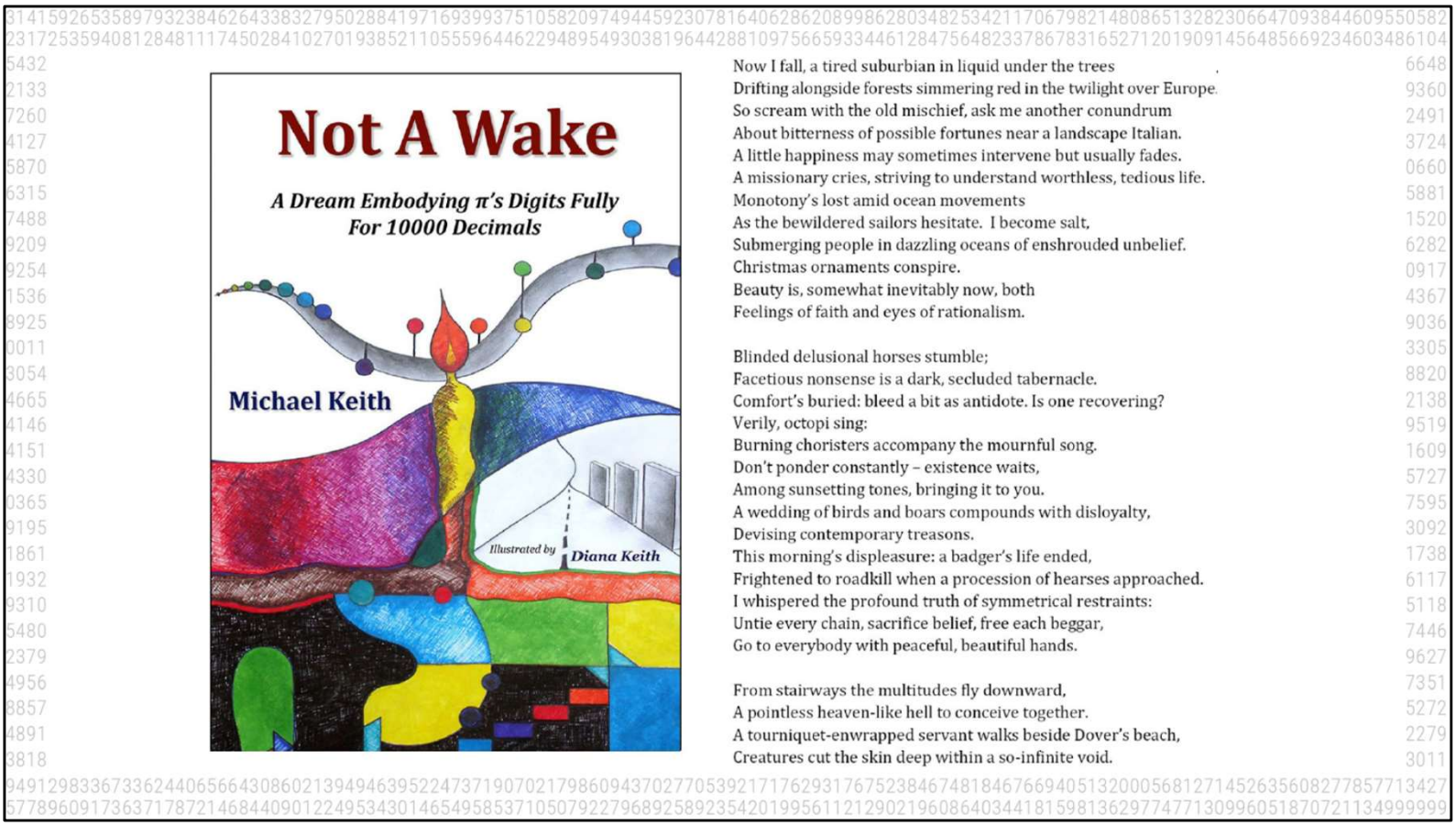
Slide 30: Another example, and another collaboration – this time with famous wordplay expert Dmitri Borgmann. Surprisingly, this one also has an astronomy theme. And it self-referentially includes "pi".

Slide 31: To be complete we must mention a few more rules:

(a) A 10-letter word represents the digit 0,

(b) Words of more than 10 letters are allowed; such a word stands for two consecutive digits (e.g., an 11-letter word represents (1, 1), and 12-letter word is (1, 2), etc.

Here the 10- and 11-letter words are in red.



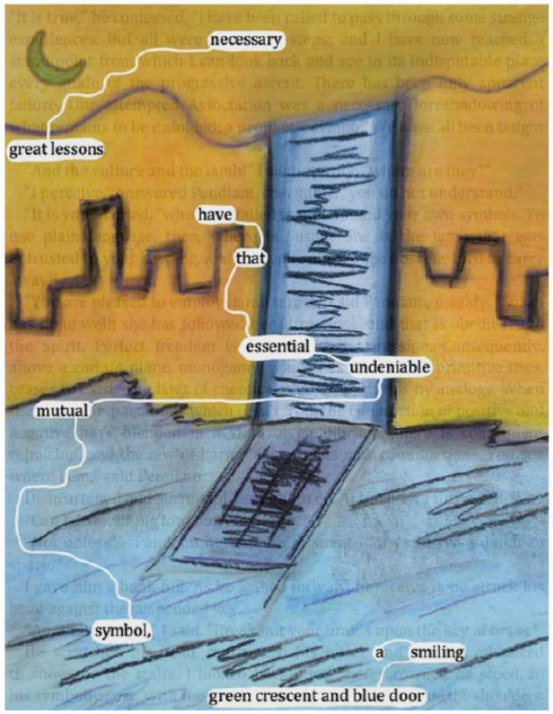
Slide 32: With those Pilish rules it's possible to keep writing longer and longer because you never run into a set of digits that can't be encoded nicely. This book, published in 2010, is the longest piece of Pilish ever published (probably the longest period, whether published or not), going to the 10,000th digit. You can find ***Not A Wake*** on Amazon (where, appropriately, its price is $\pi^2+\sqrt{\pi}$ dollars – and the e-book version is $3.14).

Green

Smiling moon-crescent, brilliantly ascending,
the skies beyond gaining outrageous yellowish colorations
resembling a hot summer's jasmine field.
A blowfly on a blossoming snapdragon searches maniacally for a snack
while forgotten landscapes of fish dissolve under sea,
depression following inevitably before sunset.
Suspected of witchcraft, the burning maiden reaches a dreamland
to be fabricated for her by an itinerant Belarusian clergyman
that for her left carnal ecstasy behind, evermore quiet.
A lady is on a boat that jostles, tumbles and pitches violently.
She remembers her elegant lunch,
a passion overpowers her.
High upon the church stands a pyramidal structure,
a projectile that penetrates the air,
turning gazes heavenwards: a longing for truth.

Blue

Amongst a cityscape, a mansion's seven doors:
ornamented with cement flat-head pilasters,
fabricated in marble for people extra grave.
Mechanically obedient, a cuckoo in an horology workshop
is sent, upon custom, to dryly declare Seven.
Sometimes a little boy can see, othertimes not.
Alongside a developing scholar is an older man,
flanking his protege just as a regiment to a king:
diligently watching, awaiting his death.
Duplicity's lifeless shades alone
account for weariness a romance becomes:
a stale, discolored, worthless supper.
Consider, as handsome downtown portals open:
without stopping to regard these chance occasions,
existence stays colorless.



Slide 33: The next few slides are examples of some of the more exotic Pilish in *Not A Wake*. This one is a pair of poems with a related illustration. The illustration is in the genre of "erasure art" – in this case, a page from some existing book is painted over except for certain words, with the visible words themselves making a statement. As required by our book (every word must be in Pilish), even the hidden message ("necessary great lessons have that…") correctly follows the digits of π.

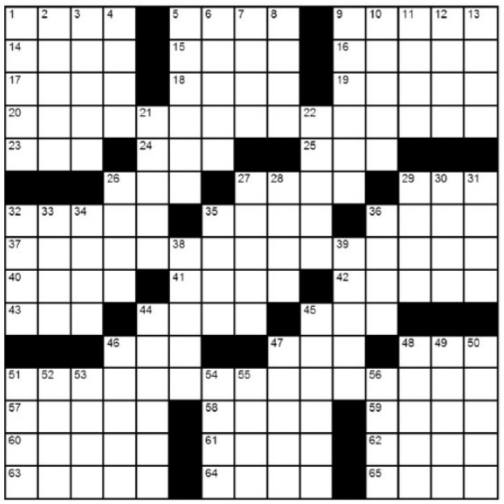
PI = A PHRASE

→ → →

1. A soapsud?
5. "Up"
9. Clearly!
14. Malevolence
15. A rhyming #16
16. So odd & creepy
17. What the hole?
18. Gap
19. Typed text out
20. (3,1,4,1,6)
23. Capricorn #
24. Luck
25. Develop wrinkles on me
26. A playmate; a sidekick
27. Roast it
29. Outdated
32. Python as "Lord"
35. Playhouse's superior seats
36. A food (chocolatey)
37. (3,1,4,1,6)
40. Resembling Jordan
41. UNDER's fellow
42. Jeopardous
43. Fore
44. Xmas
45. Put ass on
46. Stick-___
47. Greenish sidefood
48. Campfire dross
51. (3,1,4,1,6)
57. Elicit; insinuate
58. Kashmiri
59. Pronto!
60. Chapeau
61. Residuelet
62. Hubby
63. Door
64. Dry (a plant)
65. Good____ (endings)

↓ ↓ ↓

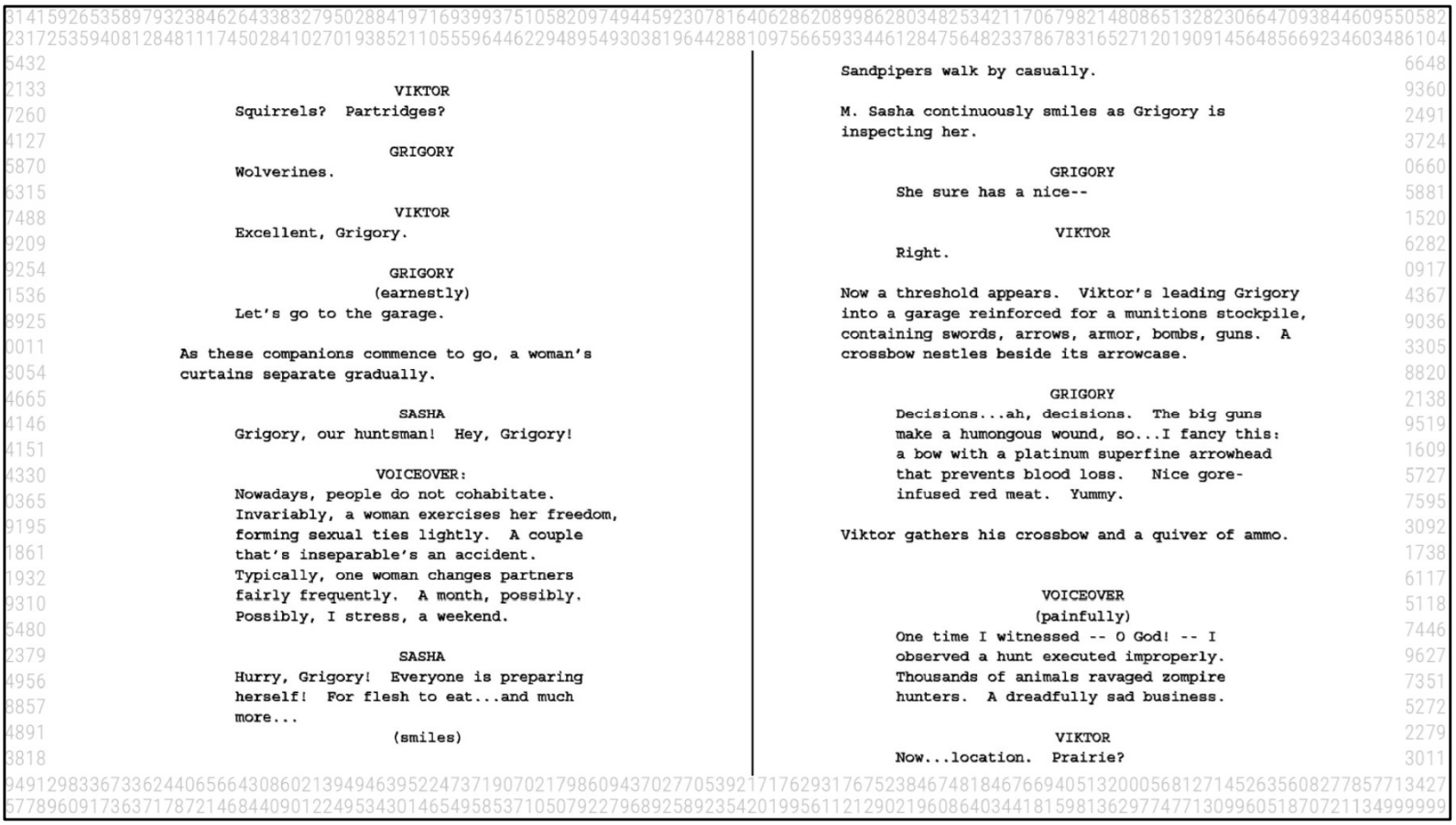
1. Circularly-shaped tunneling
2. Pointy water-cruiser
3. Cars perform this
4. Table
5. Numbered story
6. Preen
7. Widespread
8. Big, big (no, BIg...no, BIG) big-foot
9. ___ ___ is a "philosophy"
10. Raptor's top habitation
11. A horse gait
12. Quote; reference
13. Note
21. Appreciate
22. Cease a siesta
26. Holds water for dousing
27. Intestine
28. ____ polysugars
29. Globes
30. Scallion
31. Marine vessel
32. It denotes [bit, bit, bit...]
33. Buttock
34. Separated peninsula
35. Adore
36. Opposite: admit
38. Individuals = zilch
39. Killed by David
44. Degrees involved
45. Vile goo
46. He is extremely cautious
47. Receiver we doctors use
48. Examine it
49. For K. Yamaguchi
50. Promotes
51. Offensive nickname
52. Kitchen thing cooking a meal
53. A plant: brimstone____
54. Stops
55. Provoke
56. Poetical subdivision



I carefully submit the whole solution and sit dejectedly, whispering "What's happening here?" Crosswords continue filling the receptacle. "Where's enduring satisfaction?" I wonder. "Unendingly to decipher puzzles?"

Shortz nods, welcoming myself to Lucifer's domain.

Slide 34: The book uses the rule that decimal digits don't "count" when mapping the word lengths to π digits (put another way, only letters of the alphabet are used). That's just enough flexibility to be able to incorporate a crossword puzzle. The clue numbers don't count, but all the words must fit into the stream of Pilish (reading down each column).



VIKTOR
Squirrels? Partridges?

GRIGORY
Wolverines.

VIKTOR
Excellent, Grigory.

GRIGORY
(earnestly)
Let's go to the garage.

As these companions commence to go, a woman's curtains separate gradually.

SASHA
Grigory, our huntsman! Hey, Grigory!

VOICEOVER:
Nowadays, people do not cohabitate. Invariably, a woman exercises her freedom, forming sexual ties lightly. A couple that's inseparable's an accident. Typically, one woman changes partners fairly frequently. A month, possibly. Possibly, I stress, a weekend.

SASHA
Hurry, Grigory! Everyone is preparing herself! For flesh to eat...and much more...
(smiles)

Sandpipers walk by casually.

M. Sasha continuously smiles as Grigory is inspecting her.

GRIGORY
She sure has a nice--

VIKTOR
Right.

Now a threshold appears. Viktor's leading Grigory into a garage reinforced for a munitions stockpile, containing swords, arrows, armor, bombs, guns. A crossbow nestles beside its arrowcase.

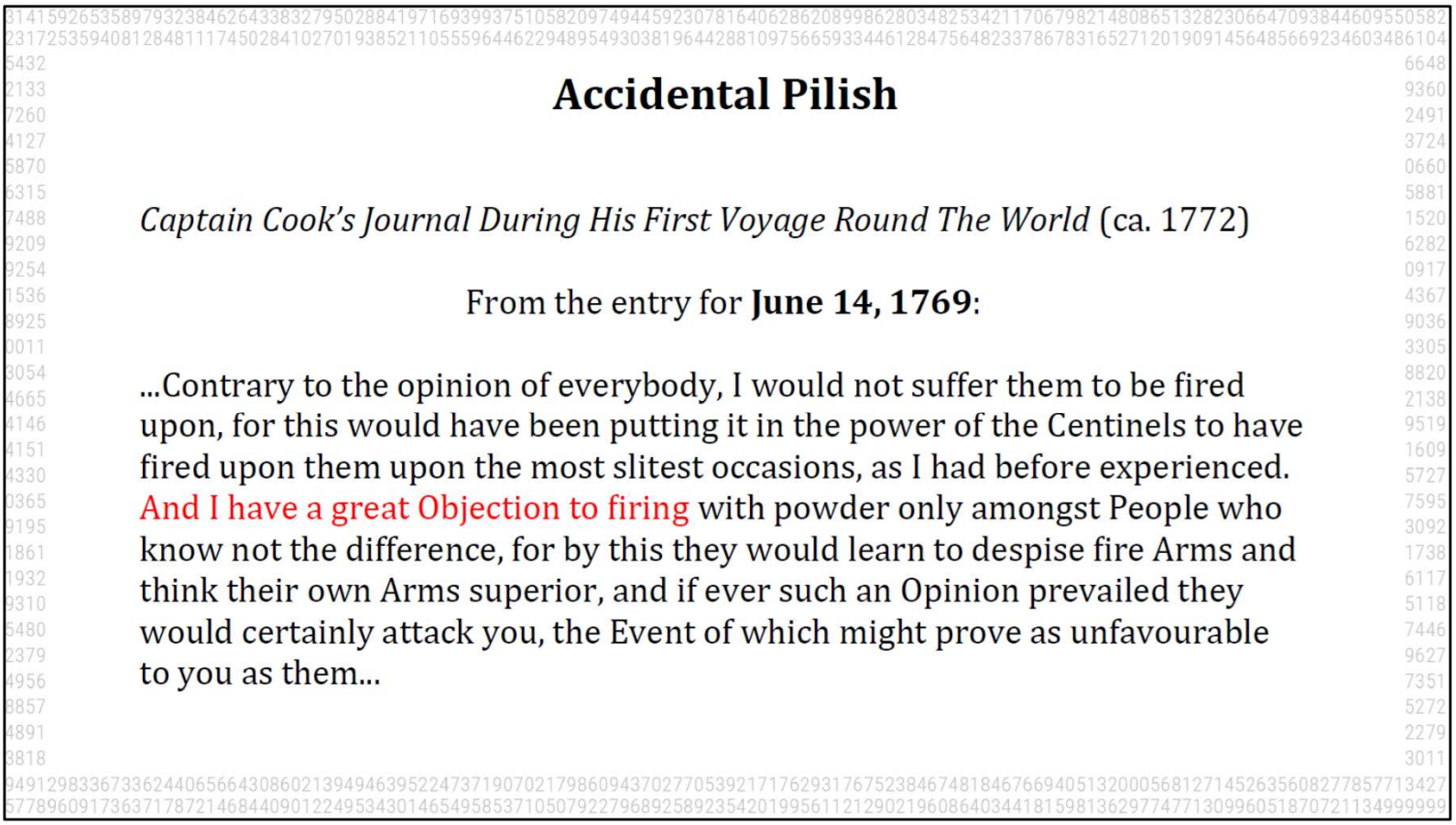
GRIGORY
Decisions...ah, decisions. The big guns make a humongous wound, so...I fancy this: a bow with a platinum superfine arrowhead that prevents blood loss. Nice gore-infused red meat. Yummy.

Viktor gathers his crossbow and a quiver of ammo.

VOICEOVER
(painfully)
One time I witnessed -- O God! -- I observed a hunt executed improperly. Thousands of animals ravaged zompire hunters. A dreadfully sad business.

VIKTOR
Now...location. Prairie?

Slide 35: This section of the book is a film script written in traditional film script style. This means that the character headings for each bit of dialog (VIKTOR, GRIGORY, etc.) must also follow the digits of π. In particular, each character can speak only when the number of digits in their name matches π's digit!



Slide 36: Besides writing your own Pilish it is interesting to look for places where it occurs accidentally. Unfortunately the very first digits of π, the 3141, are quite difficult to deal with, so that makes it even harder to find examples. But here is a nice one giving eight digits (3.1415926). Cook's log entry was exactly three months after Pi Day!

The World Record (10 digits, two known examples)

From a model railroading online forum, written Dec 2009:

3 1 4 15 9 2 6 5 3

David has given you a very straightforward procedure to follow. Since you have not done any CV programming...

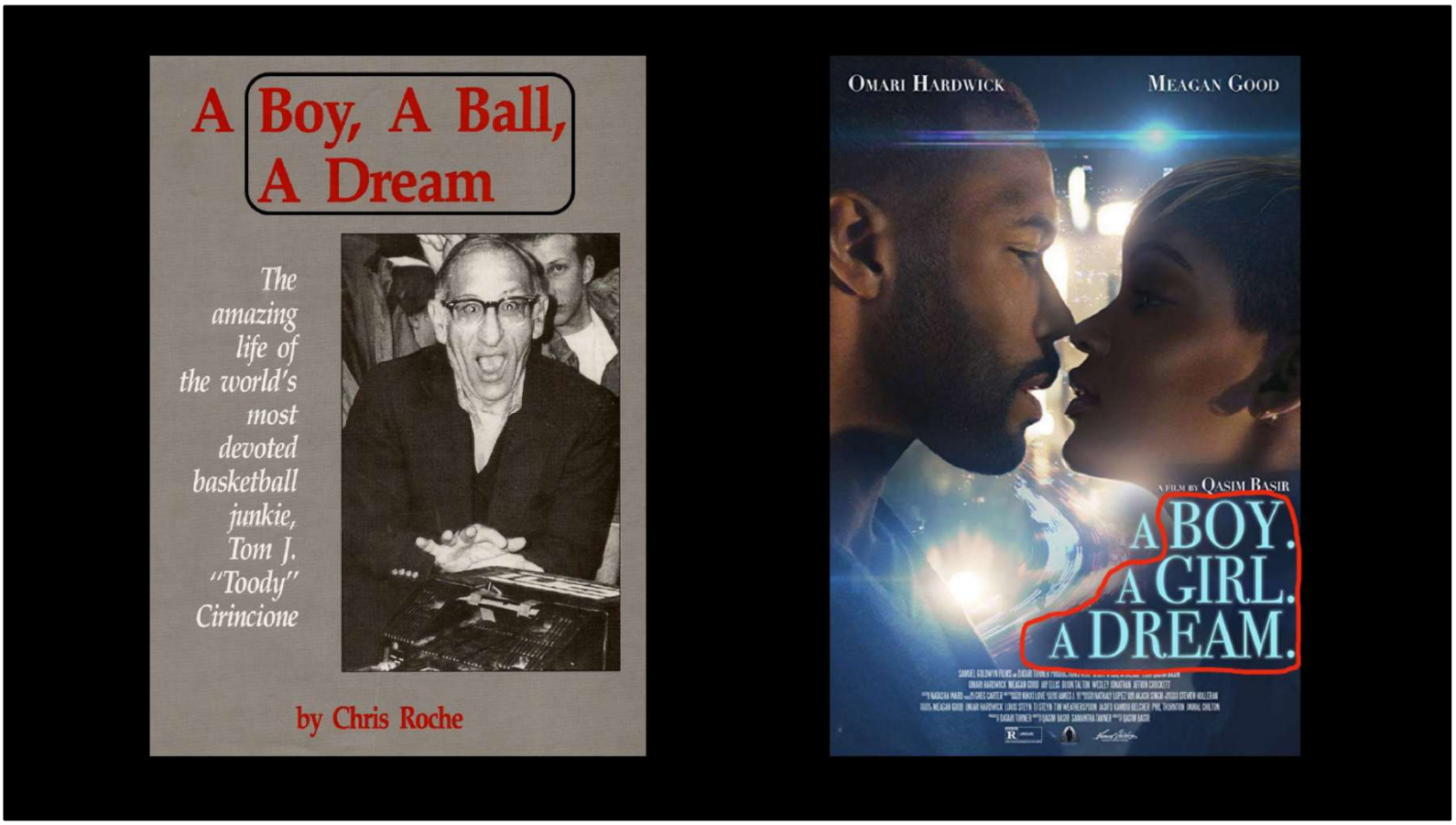
From a diabetes online forum, written Aug 2013:

3 1 4 1 5 9 2 6 5 3

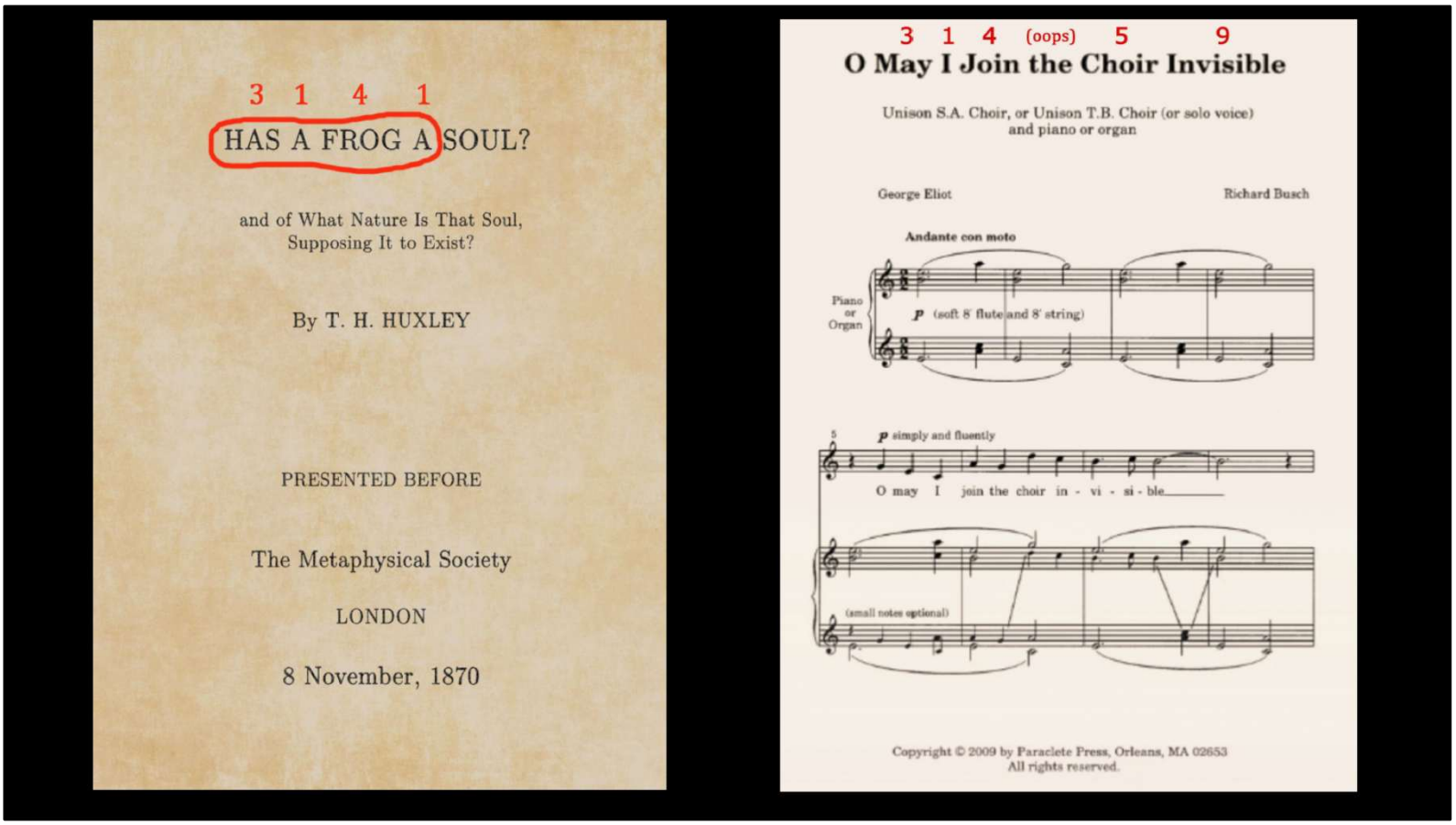
I wake up when LO and I have a small container of orange juice and a package of peanut butter crackers.

Slide 37: These are the two current records for accidental Pilish, both encoding 10 digits.

Slide 38: Yes, it’s even possible to spot Pilish in a movie or TV show, thanks to subtitles.



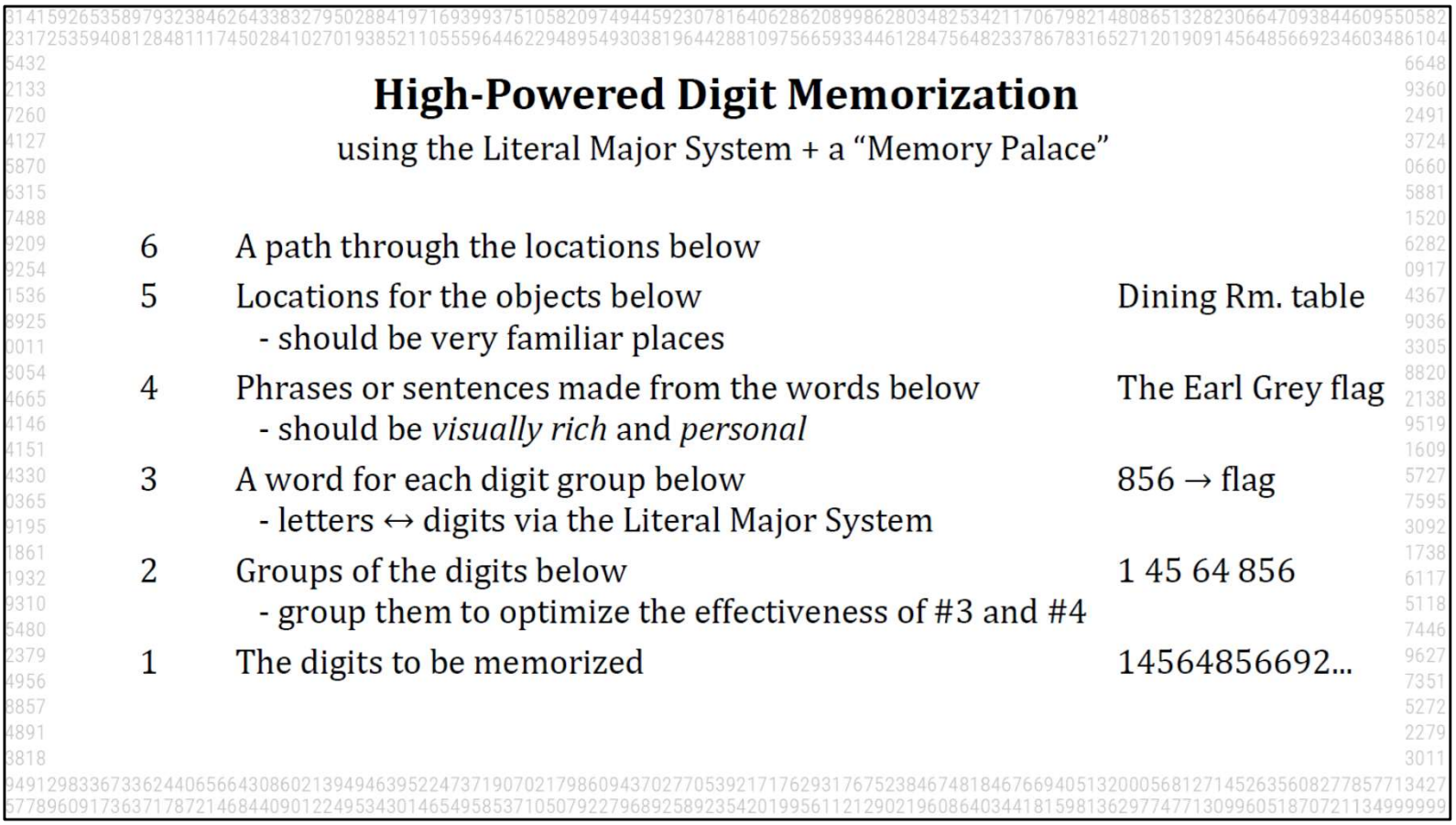
Slide 39: Here's accidental Pilish in the title of a book and the title of a movie.



Slide 40: Here's more: in an 1870 scientific paper, and a 2009 choral work based on a George Eliot poem.

Slide 41: Appearances of the number 314 in movies/TV seems to be more common than you'd expect – these are just a few examples I've spotted. The lower right one is the most intriguing – it's from the first episode of the second season of Twin Peaks (which is chock full of minutiae already). Dale Cooper's room at the Great Northern was 315, and here we can see room 314 across the hall.

Slide 42: At this point you should not be surprised that I actually have this dollar bill in my possession.



Slide 43: Final topic: a high-powered method for memorizing many digits of π. You should read this slide from bottom to top. First we use a one-to-many mapping of digits to letters to turn the digits of π into words, then we make memorable phrases or sentences out of the words. Thinking of those as "things", we place those things in sub-locations of some real place (a classic example would be various rooms in the house you live in), and then define a path for "walking" from object to object. The location-based aspect of this is usually called a "Memory Palace". See Wikipedia article "Method of Loci" for more on this.

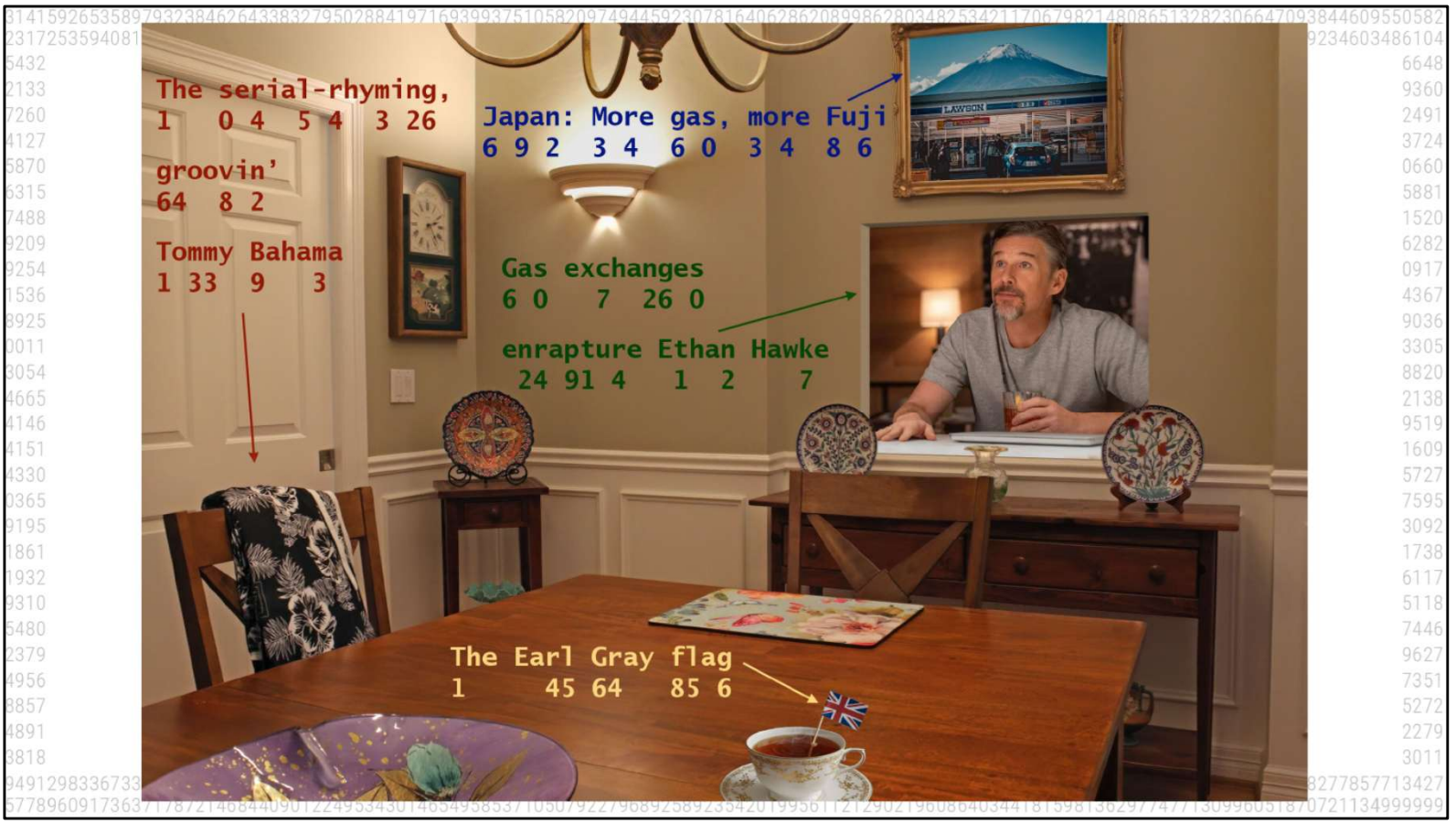
The Literal Major System

- The standard "Major System" is *phonetic*. Making it *literal* is more precise.

0	z s	zero
1	t d	T has 1 vertical line
2	n	n has 2 vertical lines
3	m	m has 3 vertical lines
4	r	four
5	L	L = 50
6	G j	G looks like 6
7	k c	k is composed of two 7's
8	f v	*f* in cursive has two loops, like 8
9	b p	b upside down looks like 9

- H, Q, W, X and the vowels AEIOUY don't represent a digit
- These "free" letters are combined with the letters above to make words.

Slide 44: Here is a complete description of the Literal Major System. (The literal version is my own invention, so you won't find it online, though there is a wealth of information about the phonetic version of the Major System.) There's a little mnemonic for each letter-to-digit mapping. When a digit has two letters, those two letters always have a related sound. A few encoding examples: ELEVATOR = 5814 (from L,V,T,R), SCAFFOLD = 078851, JAPAN = 692.



Slide 45: Here's a real example using this technique for the 50 digits of π from the 251st to the 300th.
The scene is the dining room in our house, with four objects described by phrases/sentences, to be visited in this order: (1) teacup, (2) Japan, (3) Tommy Bahama, and (4) Ethan Hawke. In this memory method the objects and their descriptions should be as weird and specific as possible to make them memorable. In this case the wildest one is the last, for which I envision a group of folks sitting at the table after dinner, trading salvos of flatulence while the actor Ethan Hawke watches from the "pass-through" opening. In other words… Gas exchanges enrapture Ethan Hawke.

Not A Muse: *the first Pilish movie*

- A 4-minute film with all spoken dialogue in Pilish.

- Single stream of 218 digits (215 words) starting at the beginning of π.

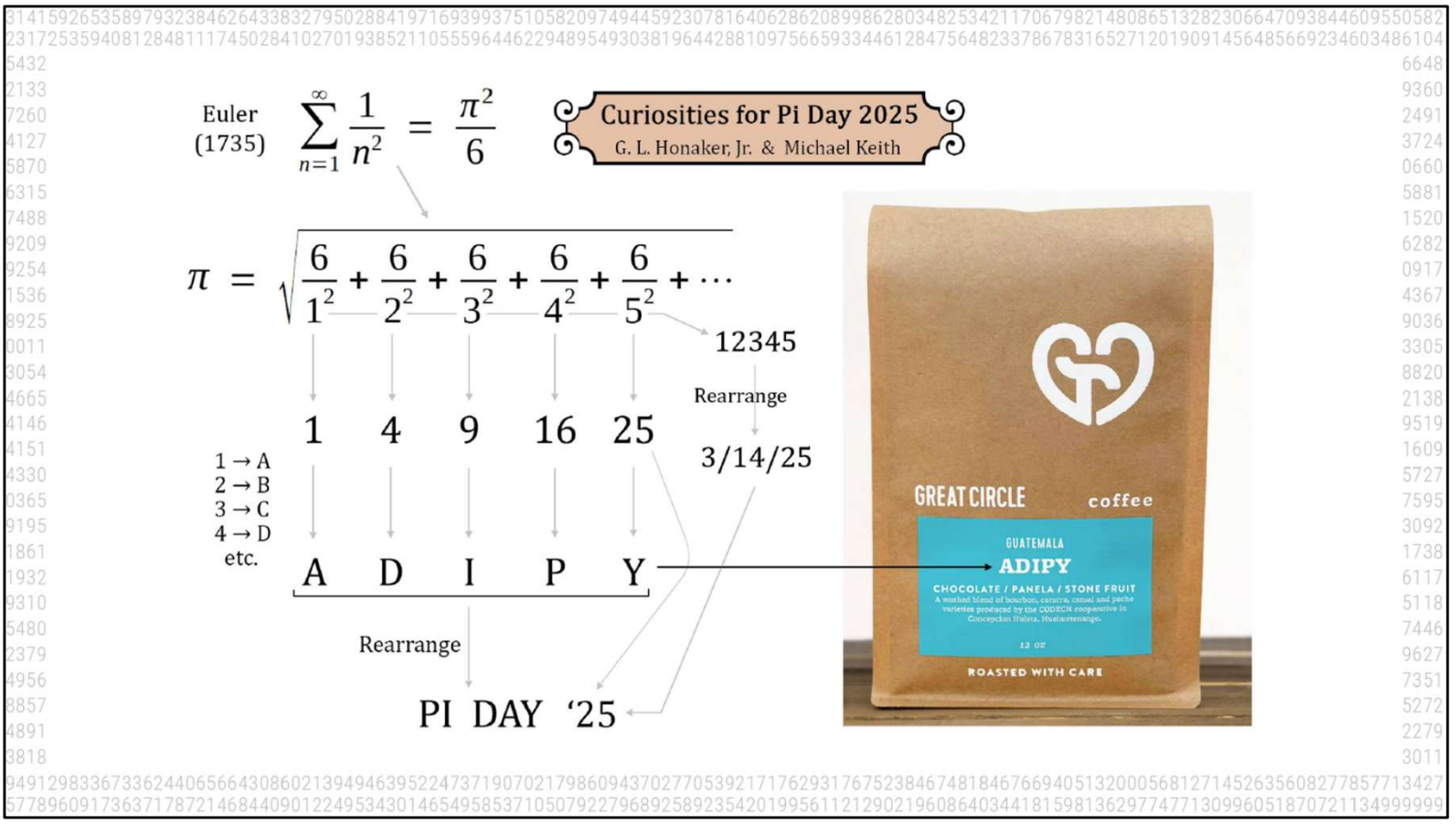
- Entirely CGI, creating using Epic Games' Unreal Engine (and editor).

- 3D environment is based on Epic's free "City Sample" world,
  modified to represent a good chunk of Manhattan and Brooklyn.

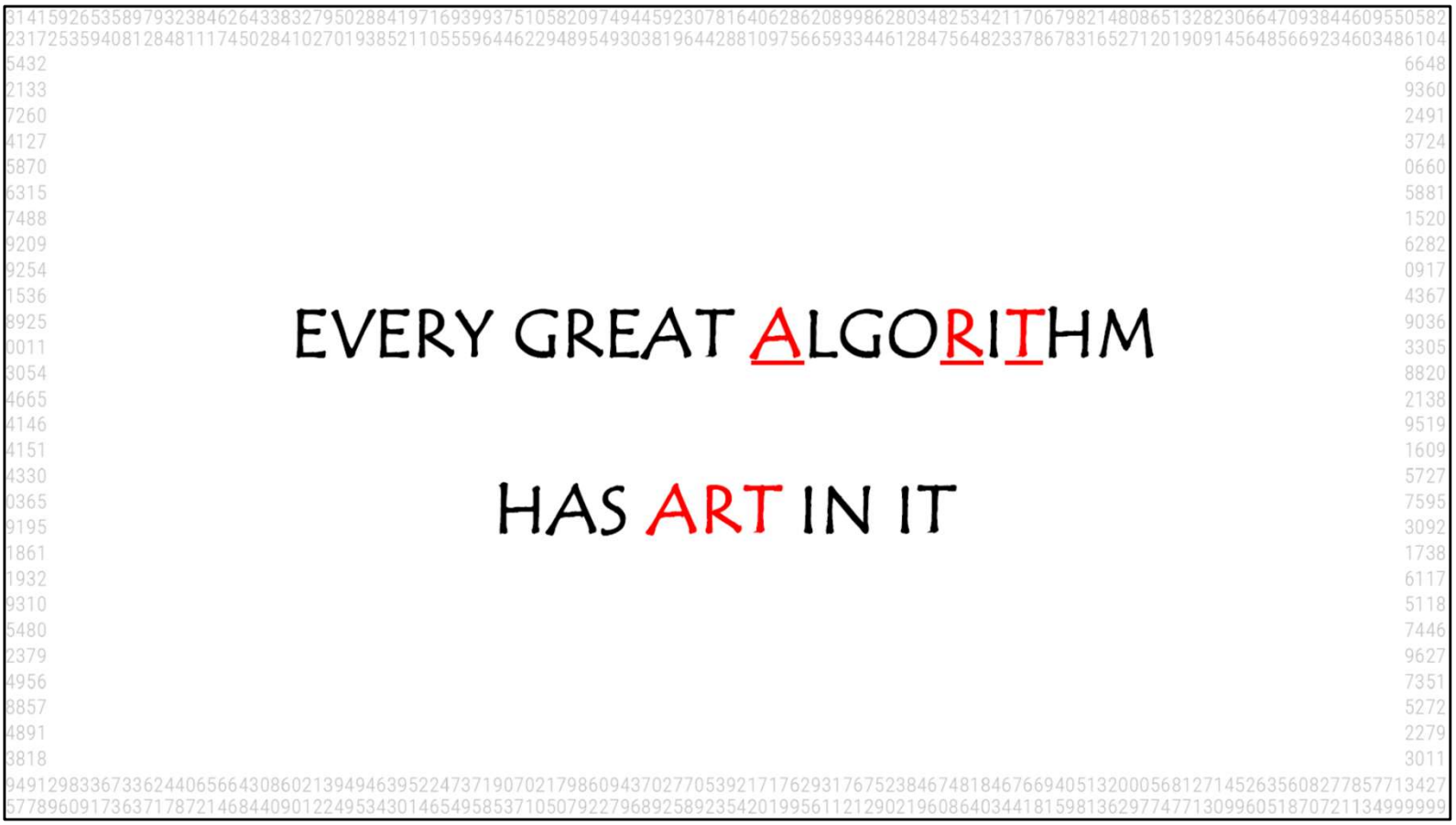
- Numerous custom objects and buildings were built from scratch,
  including the bookstore with ~ 20,000 individual books.

- Challenge: make the language as natural as possible
  ("hide" the Pilish constraint)

Slide 46: A few notes on ***Not A Muse***, a short film whose dialogue is a single stream of Pilish. Today's showing [Mar. 20, 2025] is its world premiere.



Slide 47: A final example of some nice coincidences involving π. Starting from Euler's formula at upper left, solve for π to get the elegant equation below, where π is simply the square root of the sum of 6 / n^2 over all natural numbers *n*. First notice that the first five values of *n* (1,2,3,4,5) can be rearranged into 3/14/25, which is π day this year! Next, the first five denominators are 1, 4, 9, 16, 25, which using the "alphabet code" become ADIPY. Rearranging those letters gives… PI DAY. But wait, there's more – ADIPY is a coffee variety sold by a company in Miami, FL whose name is… Great Circle! Having come full circle, we are done.



Slide 48: A little parting message.

Thanks for reading!