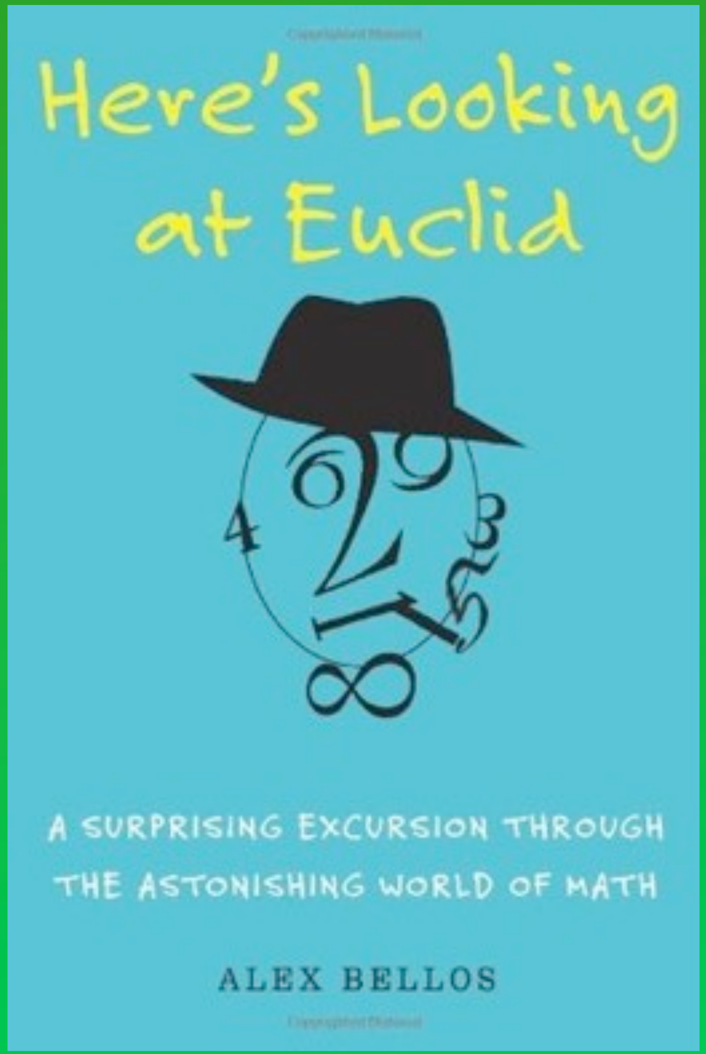
A surprising excursion through the astonishing world of math

Ronald Bradford

A Review

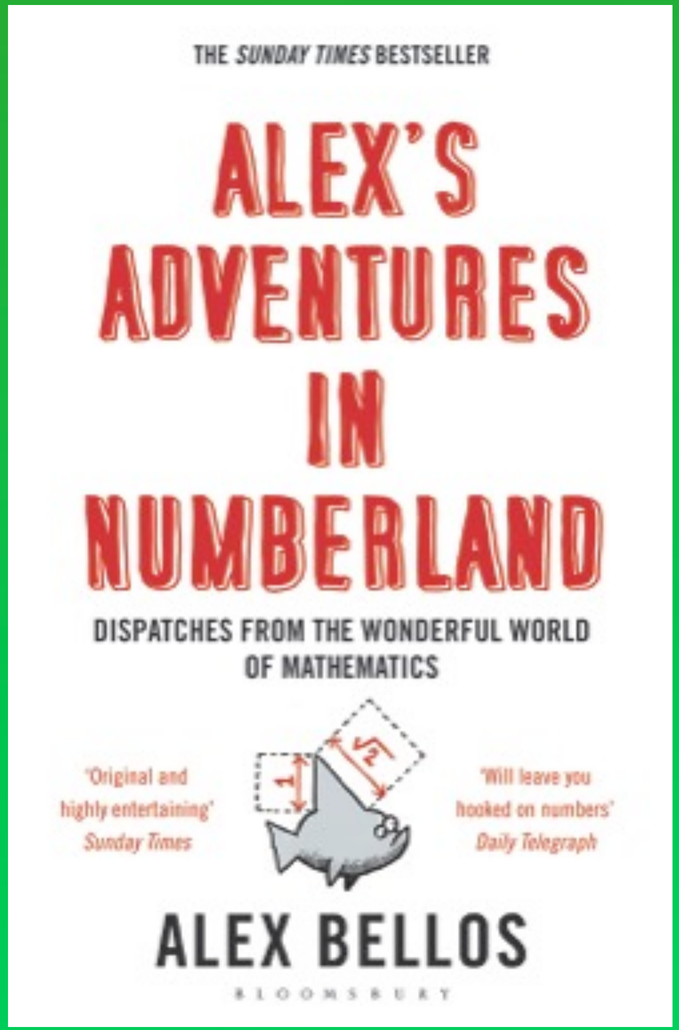
- “Here’s looking at Euclid” by Alex Bellos

http://www.alexbellos.com/



<– In US

Rest of the world –>



Counting

- We use Base 10 for counting, likely for 10 physical digits
- 1,2,3,4,5,6,7,8,9,10

- Historically there was no representation for 0
  - No roman numeral for 0

Metric System (i.e. Base 10)

- 10x10x10 (1000) millimetres in a metre
- 1000 metres in a kilometre
- 1000 grams in a kilogram
- 1000 millileters in a litre
- 100 degrees between water melting and boiling (0-100C)

https://en.wikipedia.org/wiki/Metric_system

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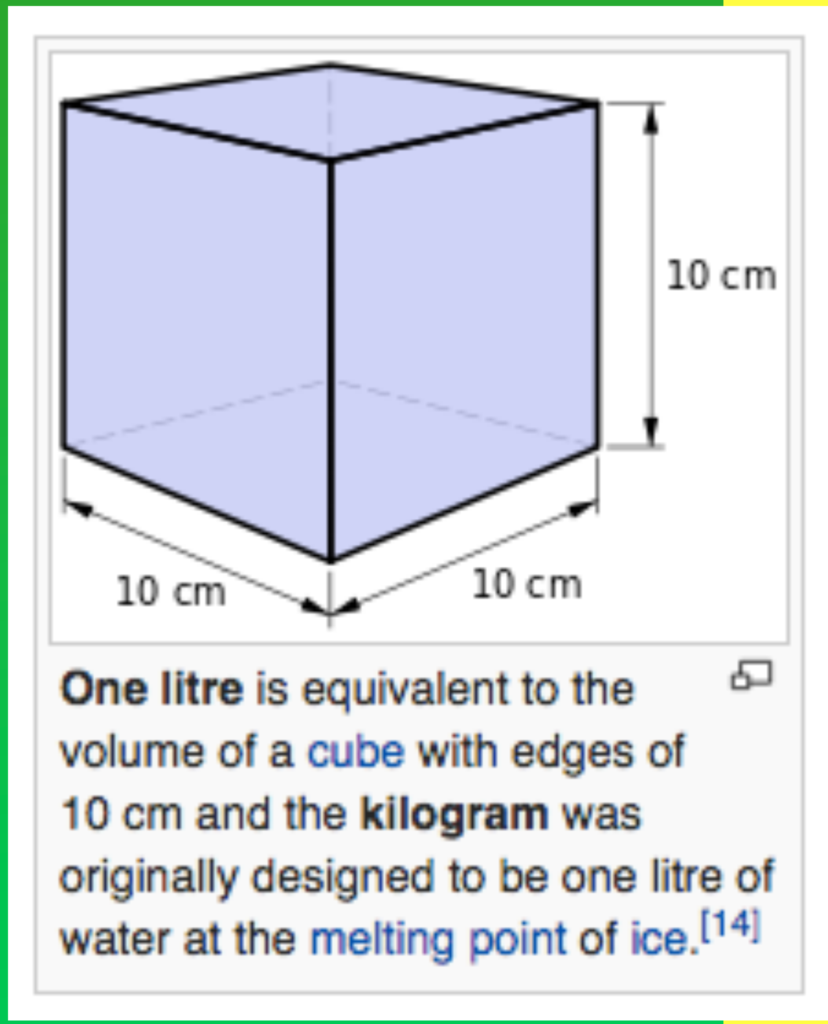

https://en.wikipedia.org/wiki/Metric_system

US Customary System

- 12 inches in a foot
- 3 feet in a yard
- 1760 feet in a mile
- 16 ounces in a pound
- 2000 pounds in a short ton, 2240 in a long ton
- 180 degrees between water melting and boiling (32-212)

https://en.wikipedia.org/wiki/United_States_customary_units

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WTF

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Base 10 words

- Most Western European Languages
  - Twenty-one, Twenty-two
  - Not tenty-one, tenty-two, but Eleven, Twelve.
  - “Between 10 and 20 is a mess”
- German is even more irregular than English
- Chineses, Japanese & Korean
  - Numbers words follow a regular pattern

Base 12

- More divisibility 2,3,4,6 verses 2,5

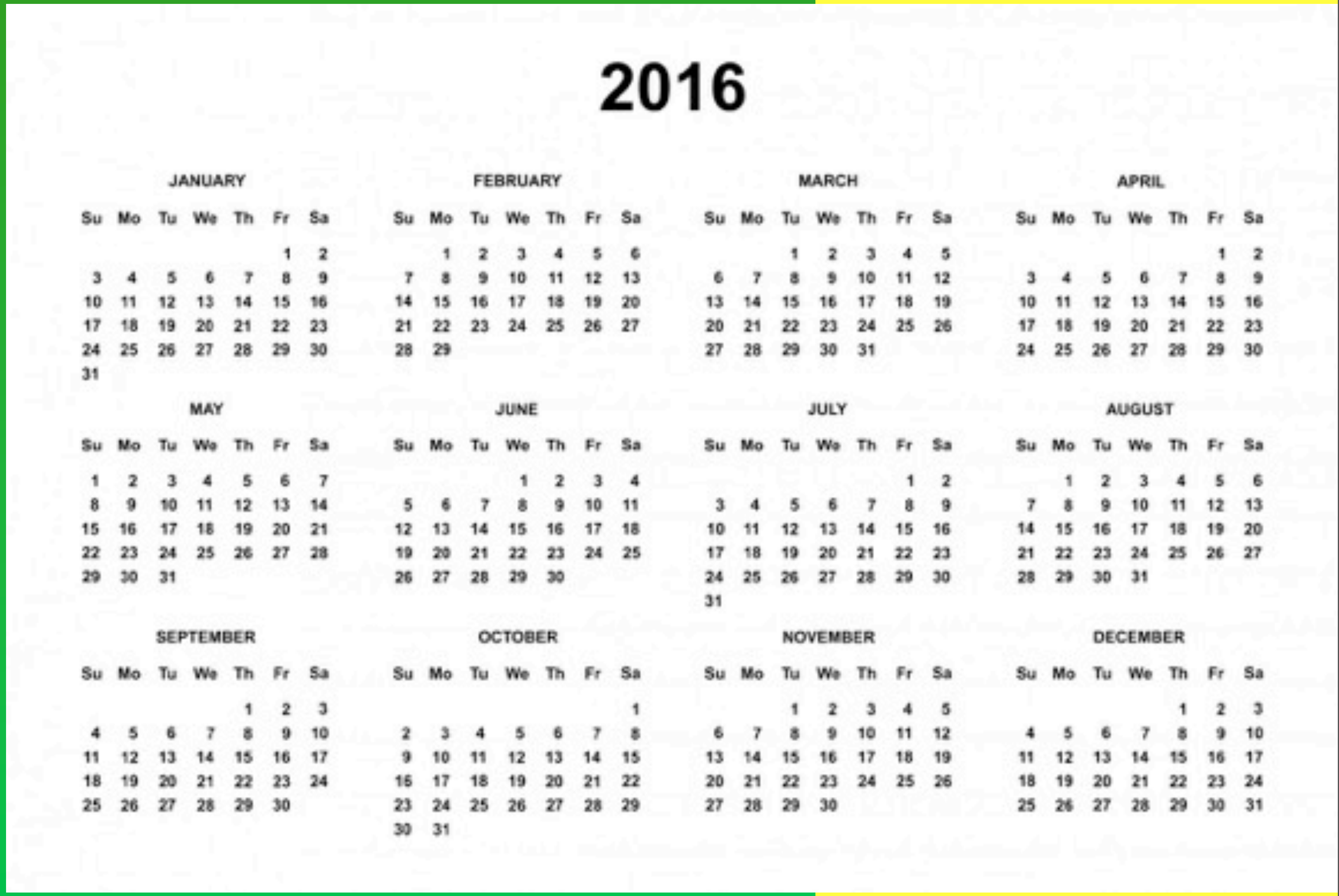
Fraction of 100	Decimal	Dozenal	
One	100	100	
Half	50	60	
Third	33.333 . . .	40	
Quarter	25	30	
Fifth	20	24;97 . . .	[The semicolon is the "dozenal point."]
Sixth	16.666 . . .	20	
Seventh	14.285	18;6X35 . . .	
Eighth	12.5	16	
Ninth	11.111 . . .	14	
Tenth	10	12;497 . . .	
Eleventh	9.09 . . .	11;11 . . .	
Twelfth	8.333 . . .	10	

Base 12

8

Base 12

- We have 12 months in the year



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- Phones have 12 digits
- There are 12 eggs in a carton

Base 20

- Historians interest
- The French for eighty is “quatre-vingtes”
- Which is “four-twenties”

Base 2 / Base 16

- Our world is
  - 101010
  - 0123456789ABCEDF

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Pythagoras and squares

- The triangles guy (6th century B.C.)

- The square of a number ‘n’ is the sum of the first ‘n’ odd numbers.
- e.g. 4x4 = 1 + 3 + 5 + 7

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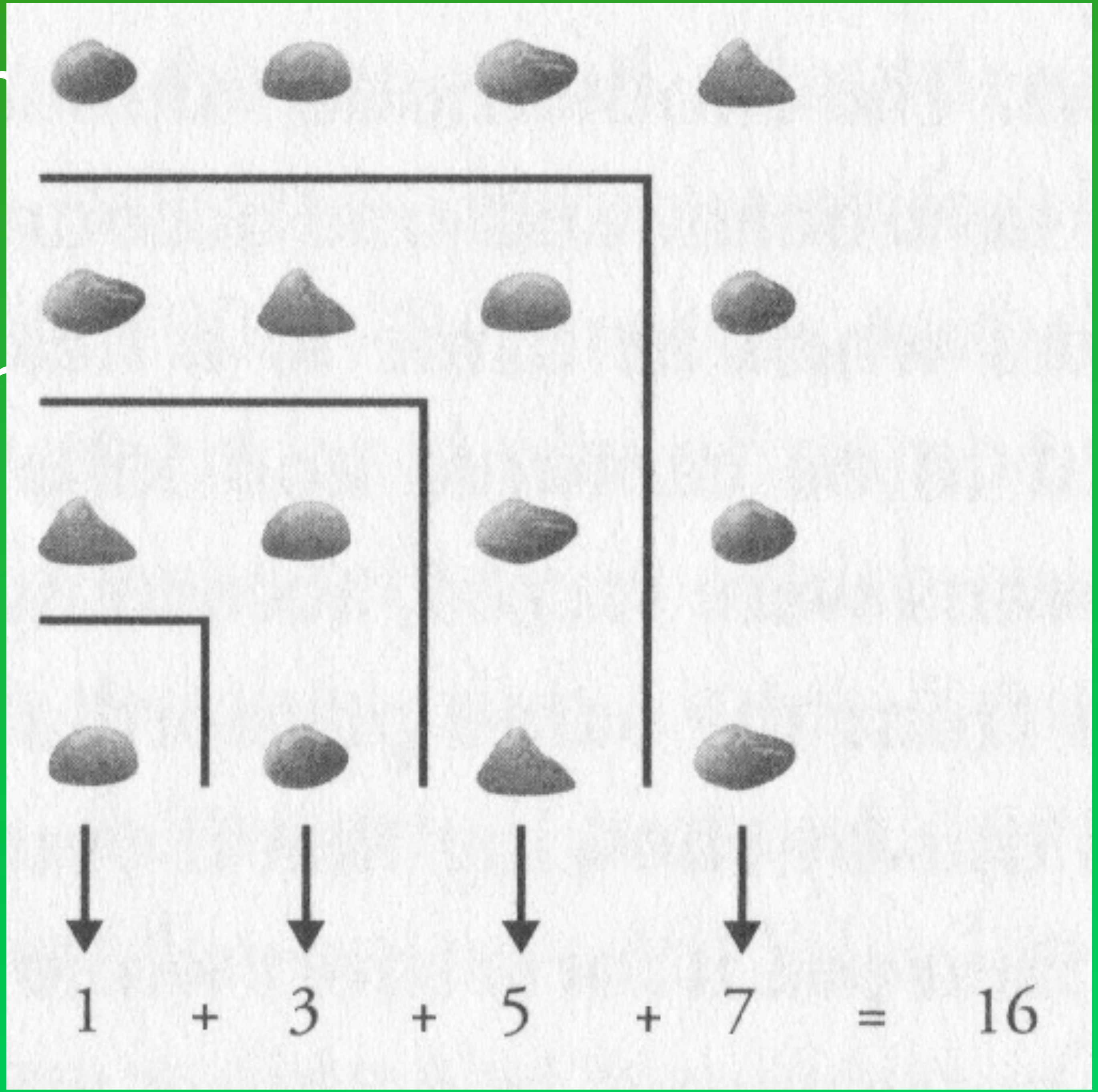


Integer Sequences

- Online Encyclopedia of Integer Sequences

  http://oeis.org/

- Odd numbers - http://oeis.org/A005408
- Prime numbers (< 20th) - http://oeis.org/A008578
- Prime numbers http://oeis.org/A000040
- Tribonacci numbers http://oeis.org/A000073
- Happy Numbers - https://oeis.org/A007770

Error Code: 139

- 34th prime number
- twin prime with 137
- sum of 5 consecutive primes (19+23+29+31+37)
- 10th term in Euclid–Mullin sequence
- 139 is a happy number

https://en.wikipedia.org/wiki/139_(number)

Error Code: 149

- 149 is the 35th prime number
- twin prime
- 149 is a emirp, because 941 is also prime
- 149 is a strong prime
- 149 is an irregular prime
- 149 is an Eisenstein prime
- 149 is a tribonacci number, being the sum of the three preceding terms, 24, 44, 81

https://en.wikipedia.org/wiki/149_(number)

What is prime?

- Is 1 prime?
- https://primes.utm.edu/notes/faq/one.html

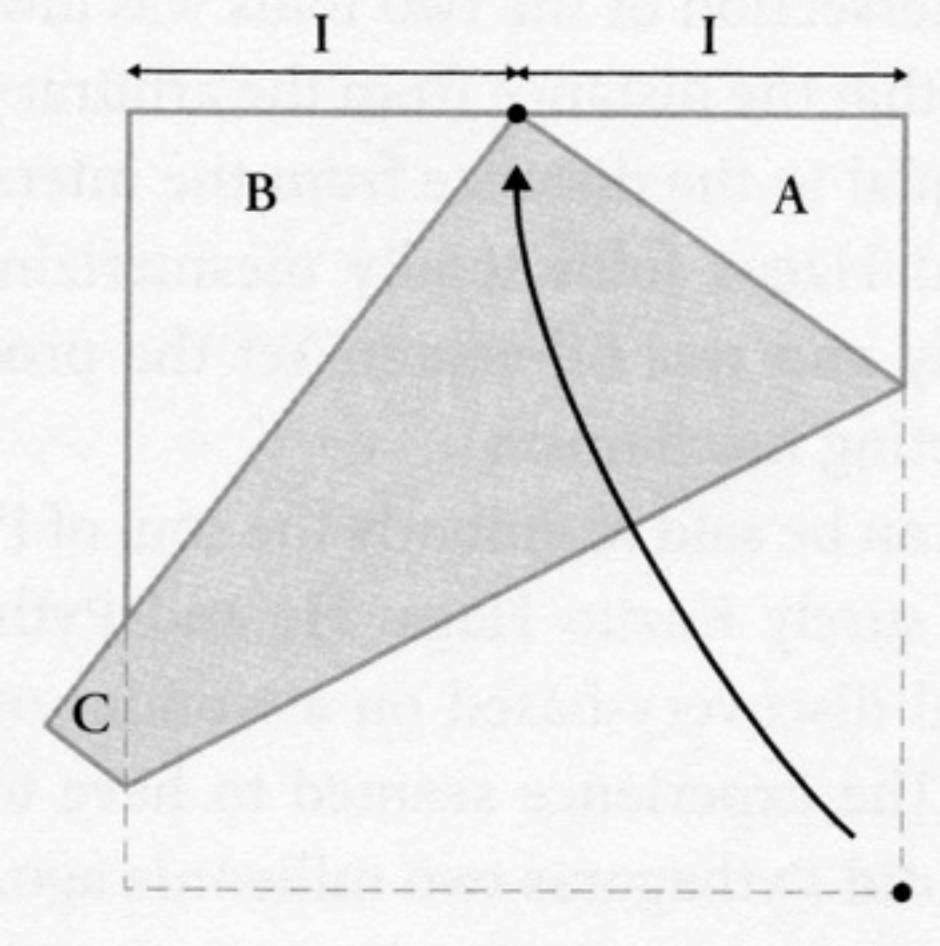
An integer ***greater than one*** is called a **prime number** if its only positive divisors (factors) are one and itself.

Origami

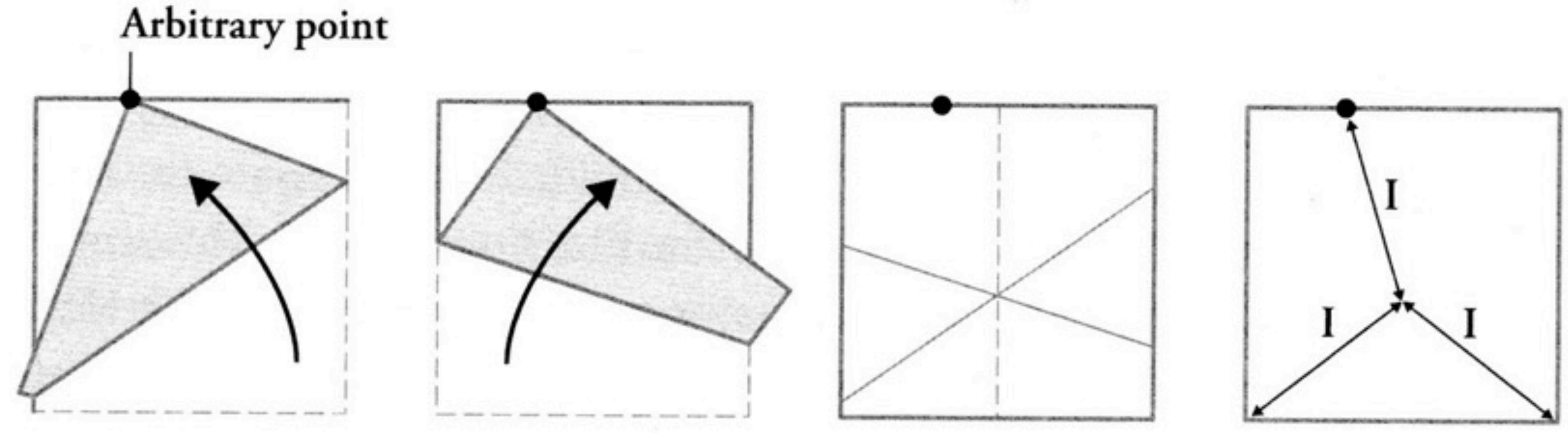
- Cutting edge of math
- Manufacturing - How many folds with one cut
- http://www.foldscope.com/ - microscope for $1
- Origami and Egyptian Triangles (The Haga theorem)

https://en.wikipedia.org/wiki/Mathematics_of_paper_folding

Origami



Haga's theorem. A, B and C are Egyptian.



Haga's other theorem.

Pi (π)

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$$\frac{1}{\pi} = \sum_{n=0}^{\infty} (-1)^n \times \frac{(6n)!}{(3n)!\, n!^3} \times \frac{163096908 + 6541681608n}{(262537412640768000)^{n+1/2}}$$

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$$\frac{\pi}{4} = \frac{1}{2} + \frac{1}{5} + \frac{1}{8} - \left[\frac{(\frac{1}{2})^3}{3} + \frac{(\frac{1}{5})^3}{3} + \frac{(\frac{1}{8})^3}{3} \right] + \left[\frac{(\frac{1}{2})^5}{5} + \frac{(\frac{1}{5})^5}{5} + \frac{(\frac{1}{8})^5}{5} \right] - \dots$$

Pi (π)

$$\frac{\text{pi}}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} \ldots$$

$$\text{pi} = 4 - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \frac{4}{9} \ldots$$

$$4 \rightarrow 2.667 \rightarrow 3.467 \rightarrow 2.895 \rightarrow 3.340 \rightarrow \ldots$$

https://en.wikipedia.org/wiki/Pi

Are Pi digits random?

of pi with a "poker test": take five consecutive digits and consider them as if they are a poker hand.

Type of hand	Actual occurrence	Expected occurrence
All digits different	604,976	604,800
One pair, three different	1,007,151	1,008,000
Two pairs	216,520	216,000
Three of a kind	144,375	144,000
Full house	17,891	18,000
Four of a kind	8,887	9,000
Five of a kind	200	200

The right column is how many times we would expect to see the poker hands if pi was normal and each decimal place had an equal chance of being occupied by any digit. The results are well within the boundaries of what we would expect. Each pattern of numbers seems to appear with the correct frequency as it would had each decimal place been randomly generated.

Math is everywhere in IT

- Algorithms (e.g. sorting, Big O)
- 2D/3D Geometry (e.g. GIS)
- Cryptography (e.g. prime numbers)
- Compression
- Image processing (e.g. animation)
- Data Structures (e.g. BTree, SQL)

Math Online

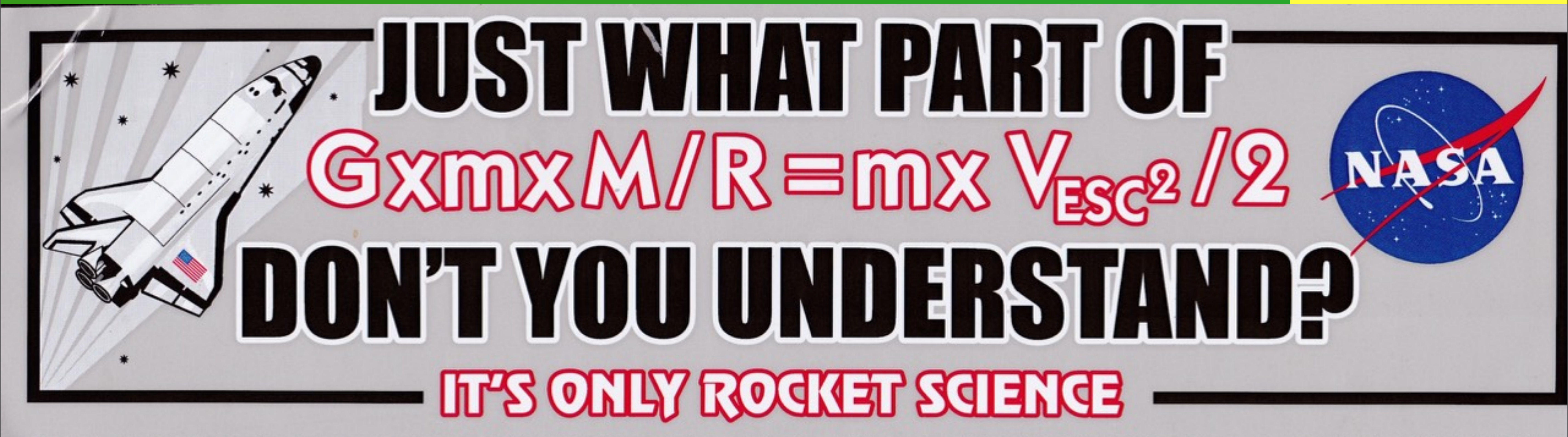
- http://mathoverflow.net/
- http://www.wolframalpha.com/
  - http://mathworld.wolfram.com/TribonacciNumber.html
- http://uniquation.com/

Emulating our humor

- Escape Velocity

https://en.wikipedia.org/wiki/Escape_velocity

Favorite Fridge Magnet



Trivia Programming Question

25

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for i = 0..9;
  for j = 0..9;
    for k = 0..9;
      do something;
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- Fortran
  - Integer variables start with i-n first letter