

# Ephemera

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Principles of Complex Systems, Vols. 1, 2, & 3D  
CSYS/MATH 6701, 6713, & a pretend number, 2024–2025

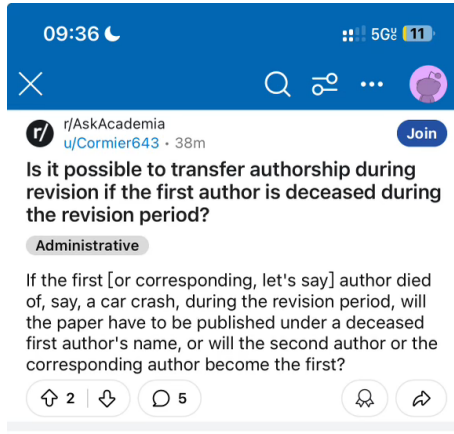
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## Planning something?



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## The nonlinearity of paper reading:

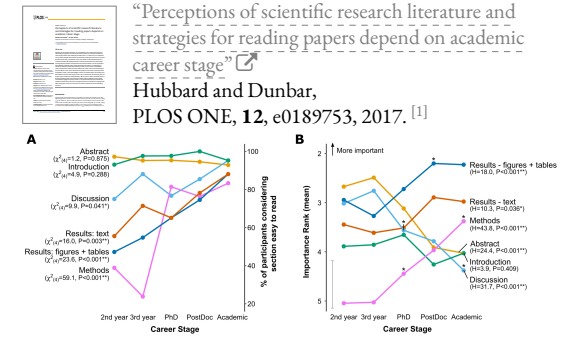


Fig 2. Different sections of scientific papers are considered easy to read and important at different stages of academic careers. A: The proportion of participants considering a section easy to read (presented as: Somewhat easy, easy, very easy) combined as a function of career stage. Results of Chi-square tests are indicated on the left hand side. B: The mean importance rank of sections as a function of career stage. Error bars are omitted from individual points for clarity, with the sole error bar in grey representing the largest 95% confidence interval for any of the data points. Asterisks above data points indicate significant differences in response compared with the previous career stage as determined by Mann-Whitney post-hoc tests.

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## Outline

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## Another great moment in loglines

Which story is this?:

Transported to a surreal landscape, a young girl kills the first person she meets and then teams up with three strangers to kill again.

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## From a 1901 autobiography by Charles Stewart

‘Buckle said, in his dogmatic way: “Men and women range themselves into three classes or orders of intelligence; you can tell the lowest class by their habit of always talking about persons; the next by the fact that their habit is always to converse about things; the highest by their preference for the discussion of ideas.”’

Distilled and misattributed as:

“Great minds discuss ideas;  
average minds discuss events;  
small minds discuss people.”

S. W. Dodds:

“And galaxy minds discuss food.”

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## Another great moment in the English language:

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## The CIA's Simple Sabotage Field Manual (1944):

### General Interference with Organizations and Production

- (1) Insist on doing everything through "channels." Never permit short-cuts to be taken in order to expedite decisions.
- (2) Make "speeches." Talk as frequently as possible and at great length. Illustrate your "points" by long anecdotes and accounts of personal experiences. Never hesitate to make a few appropriate "patriotic" comments.
- (3) When possible, refer all matters to committees, for "further study and consideration." Attempt to make the committees as large as possible — never less than five.
- (4) Bring up irrelevant issues as frequently as possible.
- (5) Haggle over precise wordings of communications, minutes, resolutions.
- (6) Refer back to matters decided upon at the last meeting and attempt to re-open the question of the advisability of that decision.
- (7) Advocate "caution." Be "reasonable" and urge your fellow-conferes to be "reasonable" and avoid haste which might result in embarrassments or difficulties later on.
- (8) Be worried about the progress of any decision — raise the question of whether such action as is contemplated lies within the jurisdiction of the group or whether it might conflict with the policy of some higher echelon.

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## From YojimboJango, Tuesday January 29, 2013 @09:12AM (#42725321), Slashdot

“I wrote this a while ago, but I find it’s useful to post it here:

- The precondition that you can write terrible code in any language is a mental diversion. You must design languages for people that believe in intelligent design.
- If there is low hanging fruit in your garden of eden, people are going to assume that someone vastly smarter than they are placed it there for plucking.
- Not even God himself coming down from on high and face to face telling every member of the human race not to touch it is going to keep it from being abused.
- That is the true nature of humanity and by inclusion programmers.”

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## Wlonk [wiktionary]

- Alternative forms:** wlanck, wlanck, wlonc, wlong
- Etymology:** From Old English wlancc, from Proto-West Germanic \*wlanke.
- Pronunciation:** IPA(key): /wlonk/, /wlank/
- Adjective:** wlonk (plural and weak singular wlonke)
  - noble, highborn
  - fair, beautiful, gorgeous
  - fine, excellent, splendid
  - proud, boastful

Suggested (ab)usage:

“Have a wlonkderful day!”

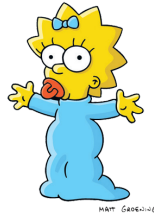
<sup>1</sup>Behavior found occurring organically everywhere in groups of all kinds.

## YojimboJango's taxonomy (1/2):

- perl:** An unorganized, but sprawling garden full of almost every imaginable fruit. Regex is a shiny sinful apple at eye level on every single tree. The only way to navigate the garden is to ask the snakes.
- python:** An organized garden that has one of each kind of fruit. But it's half way through being dug up and replanted into an even more organized garden.
- ruby:** A newer garden. Heaps of fertilizer make everything grow incredibly fast, but the trees are getting tangled and there's a problem with weeds.
- C#:** Someone spent a lot of money crafting this garden correctly. They also planted trees that emit a hypnotic pollen that will murder you if you try to leave the garden.

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## Universal numbers



From here ↗

- Accidents of evolution<sup>1</sup> give us  $5 + 5 = 10$  fingers and hence base 10.
- We could be happy with base 6, 8, 12, ...
- We like these:
  - 60 seconds in a minute
  - 60 minutes in an hour.
  - $2 \times 12 = 24$  hours in a day.
  - 360 degrees in a circle.

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## Superior highly composite numbers: ↗

| # prime factors | SHCN n | prime factorization                               | prime exponents  | # divisors d(n)        | primorial factorization          |
|-----------------|--------|---|------------------|------------------------|----------------------------------|
| 1               | 2      | 2   | 1                | 2                      | 2                                |
| 2               | 6      | 2 · 3   | 1, 1             | 2 <sup>2</sup>         | 4 · 6                            |
| 3               | 12     | 2 <sup>2</sup> · 3                                | 2, 1             | 3 × 2                  | 6 · 2 · 6                        |
| 4               | 60     | 2 <sup>3</sup> · 3 · 5                            | 2, 1, 1          | 3 × 2 <sup>2</sup>     | 12 · 2 · 30                      |
| 5               | 120    | 2 <sup>3</sup> · 3 · 5                            | 3, 1, 1          | 4 × 2 <sup>2</sup>     | 16 · 2 <sup>2</sup> · 30         |
| 6               | 360    | 2 <sup>3</sup> · 3 <sup>2</sup> · 5               | 3, 2, 1          | 4 × 3 × 2              | 24 · 2 · 6 · 30                  |
| 7               | 2520   | 2 <sup>3</sup> · 3 <sup>2</sup> · 5 · 7           | 3, 2, 1, 1       | 4 × 3 × 2 <sup>2</sup> | 48 · 2 · 6 · 210                 |
| 8               | 5040   | 2 <sup>4</sup> · 3 <sup>2</sup> · 5 · 7           | 4, 2, 1, 1       | 5 × 3 × 2 <sup>2</sup> | 60 · 2 <sup>2</sup> · 6 · 210    |
| 9               | 55440  | 2 <sup>4</sup> · 3 <sup>2</sup> · 5 · 7 · 11      | 4, 2, 1, 1, 1    | 5 × 3 × 2 <sup>2</sup> | 120 · 2 <sup>2</sup> · 6 · 2310  |
| 10              | 720720 | 2 <sup>4</sup> · 3 <sup>2</sup> · 5 · 7 · 11 · 13 | 4, 2, 1, 1, 1, 1 | 5 × 3 × 2 <sup>2</sup> | 240 · 2 <sup>2</sup> · 6 · 30030 |

- SHCN = natural number  $n$  whose number of divisors exceeds that of any other number when scaled relative to itself in a sneaky way:

$$\frac{d(n)}{n^\epsilon} \geq \frac{d(j)}{j^\epsilon} \text{ and } \frac{d(n)}{n^\epsilon} > \frac{d(k)}{k^\epsilon}$$

for  $j < n < k$  and some  $\epsilon > 0$ .

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## YojimboJango's taxonomy (2/2):

- java:** A beautiful garden but only when viewed from space. Every tree has exactly 1 fruit, and getting anywhere takes forever. Recently taken over by someone interested in C#'s hypnotic pollen trees.
- C++:** An industrial farm complete with tractors and combine harvesters, but no safety equipment. As a bonus 98% of the farm does not contain buried land mines.
- C:** A plot of land and a barn full of seeds. Get to work.
- javascript:** There's only 1 tree and it grows upside down, but you can find it resurfacing in all the other gardens. It's also sentient, growing rapidly, and trying to murder you.

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## Maybe 5 fingers are not an accident ↗

### We've liked these kinds of numbers for a long time: ↗

|           |            |             |              |               |                |                 |                  |                   |                    |
|-----------|------------|-------------|--------------|---------------|----------------|-----------------|------------------|-------------------|--------------------|
| ¶ 1       | ¶¶ 2       | ¶¶¶ 3       | ¶¶¶¶ 4       | ¶¶¶¶¶ 5       | ¶¶¶¶¶¶ 6       | ¶¶¶¶¶¶¶ 7       | ¶¶¶¶¶¶¶¶ 8       | ¶¶¶¶¶¶¶¶¶ 9       | ¶¶¶¶¶¶¶¶¶¶ 10      |
| ¶¶ 11     | ¶¶¶ 12     | ¶¶¶¶ 13     | ¶¶¶¶¶ 14     | ¶¶¶¶¶¶ 15     | ¶¶¶¶¶¶¶ 16     | ¶¶¶¶¶¶¶¶ 17     | ¶¶¶¶¶¶¶¶¶ 18     | ¶¶¶¶¶¶¶¶¶¶ 19     | ¶¶¶¶¶¶¶¶¶¶¶ 20     |
| ¶¶¶ 21    | ¶¶¶¶ 22    | ¶¶¶¶¶ 23    | ¶¶¶¶¶¶ 24    | ¶¶¶¶¶¶¶ 25    | ¶¶¶¶¶¶¶¶ 26    | ¶¶¶¶¶¶¶¶¶ 27    | ¶¶¶¶¶¶¶¶¶¶ 28    | ¶¶¶¶¶¶¶¶¶¶¶ 29    | ¶¶¶¶¶¶¶¶¶¶¶¶ 30    |
| ¶¶¶¶ 31   | ¶¶¶¶¶ 32   | ¶¶¶¶¶¶ 33   | ¶¶¶¶¶¶¶ 34   | ¶¶¶¶¶¶¶¶ 35   | ¶¶¶¶¶¶¶¶¶ 36   | ¶¶¶¶¶¶¶¶¶¶ 37   | ¶¶¶¶¶¶¶¶¶¶¶ 38   | ¶¶¶¶¶¶¶¶¶¶¶¶ 39   | ¶¶¶¶¶¶¶¶¶¶¶¶¶ 40   |
| ¶¶¶¶¶ 41  | ¶¶¶¶¶¶ 42  | ¶¶¶¶¶¶¶ 43  | ¶¶¶¶¶¶¶¶ 44  | ¶¶¶¶¶¶¶¶¶ 45  | ¶¶¶¶¶¶¶¶¶¶ 46  | ¶¶¶¶¶¶¶¶¶¶¶ 47  | ¶¶¶¶¶¶¶¶¶¶¶¶ 48  | ¶¶¶¶¶¶¶¶¶¶¶¶¶ 49  | ¶¶¶¶¶¶¶¶¶¶¶¶¶¶ 50  |
| ¶¶¶¶¶¶ 51 | ¶¶¶¶¶¶¶ 52 | ¶¶¶¶¶¶¶¶ 53 | ¶¶¶¶¶¶¶¶¶ 54 | ¶¶¶¶¶¶¶¶¶¶ 55 | ¶¶¶¶¶¶¶¶¶¶¶ 56 | ¶¶¶¶¶¶¶¶¶¶¶¶ 57 | ¶¶¶¶¶¶¶¶¶¶¶¶¶ 58 | ¶¶¶¶¶¶¶¶¶¶¶¶¶¶ 59 | ¶¶¶¶¶¶¶¶¶¶¶¶¶¶¶ 60 |

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## There's more: Superabundant numbers ↗

- $n$  is superabundant if:

$$\frac{\sigma_1(n)}{n} > \frac{\sigma_1(j)}{j}$$

for  $j < n$  and where  $\sigma_x(n) = \sum_{d|n} d^x$  is the divisor function.

- 449 numbers are both superabundant and highly composite.

## Yet more: Colossally abundant numbers: ↗

- $n$  is colossally abundant if for all  $j$  and some  $\epsilon > 0$ :

$$\frac{\sigma_1(n)}{n^{1+\epsilon}} \geq \frac{\sigma_1(j)}{j^{1+\epsilon}}$$

- Infinitely many but only 22 less than  $10^{18}$ .

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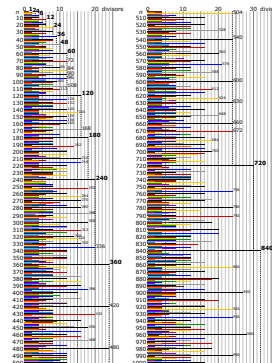
## Once was DodecaPoCS

### Twelve is a hero:

- 12 is a superior highly composite number, highly totient, and super abundant.
- 12 is one of only two known sublime numbers, for which both the number and sum of their positive factors are perfect numbers (6 and 28).
- Compositeness means the Duoedecimal System is for Winners: 12 hours in half a day, 12 inches in a foot.<sup>2</sup>
- 'Twelve', 'twelfth', and 'twelvish' all have excellent speakfeel.
- And 'dozen'. 'Dozen', 'dozen', 'dozen'.
- Related: The Rampaging On-Line Encyclopedia of Integer Sequences, <https://oeis.org>.

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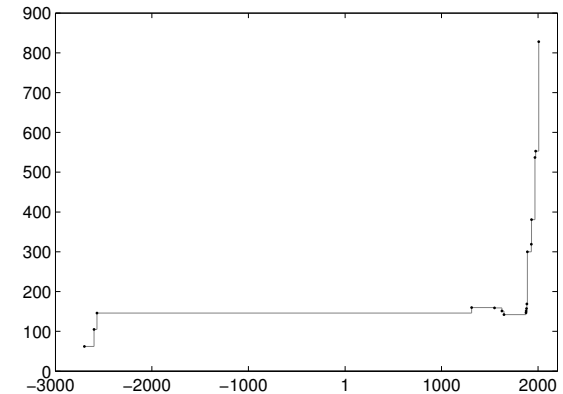
## Highly composite numbers: ↗



- HCN = natural number with more divisors than any smaller natural number.
- 2, 4, 6, 12, 24, 36, 48, 60, 120, 180, 240, 360, 720, 840, 1260, 1680, 2520, 5040 (Plato's optimal city population), ...
- OEIS sequence A002182

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## What's this?



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<sup>2</sup>Metric-Schmetric

## The walkie-talkie dialect:<sup>3</sup>

- 📞 Stamps: Lickie Stickie
- 📞 Defibrillators: Heartie Startie
- 📞 Bumble bees: Fuzzie Buzzie
- 📞 Pregnancy test: Maybe Baby
- 📞 Fork: Stabbie Grabbie
- 📞 Socks: Feetie Heatie
- 📞 Hippo: Floatie Bloatie
- 📞 Nightmare: Screamie Dreamie

<sup>3</sup>From the inciting tweet of excellence:  
<https://twitter.com/Flaminhaystack/status/977899605349339137>

## How does these feel?

- 📞 “orange lovely knife”,
- 📞 “rectangular old knife”,
- 📞 “Victorian little knife”,
- 📞 “whittling little knife”.
- 📞 “A whittling, steel, Victorian, orange, rectangular, old, little, lovely, knife.”

## The exception to the rule proves the rule:<sup>5</sup>

### Vowel sequencing overrules adjective ordering:

- 📞 Order: opinion - size - age - shape - color - origin - material - purpose.
- 📞 Little Red Riding Hood (okay: size - color - purpose).
- 📞 Big Bad Wolf (vowel ordering wins: size - opinion).
- 📞 Lon-lat is horizontal-vertical ( $x$ - $y$ ) but doesn't sound good.
- 📞 Lat-lon sounds good but is vertical-horizontal ( $y$ - $x$ ). Yikes.
- 📞 (Separately:  $x$ - $y$  is sensibly alphabetic, but we have made an abstraction concrete.)
- 📞 Trouble-at-mill: Twitter has in the past had lon-lat and lat-lon in a single tweet's json.

<sup>4</sup>[https://en.wikipedia.org/wiki/Coodabeen\\_Champions](https://en.wikipedia.org/wiki/Coodabeen_Champions)

## More:

- 📞 Ambulance: Sendie Mendie
- 📞 Miniature sausage dog: Teenie Weenie
- 📞 Shot glass: Dinkie Drinkie
- 📞 Lifejacket: Boatie Coatie
- 📞 Low fat desserts: Fakey Cakey
- 📞 Cat: Furrie Purrie

## Adjective order in English: [↗](#)<sup>4</sup>

“Adjectives in English absolutely have to be in this order:  
opinion - size - age - shape - colour - origin - material - purpose.

So you can have a lovely, little, old, rectangular, green,  
Victorian, steel, whittling knife.

But if you mess with that word order in the slightest you'll  
sound like a maniac.

It's an odd thing that every English speaker uses that list, but  
almost none of us could write it out.”

## Europe:

- 📞 Many errors called out in comments. Why hasn't this been done well?

A small task—Order the following adjectives to describe a  
knife (alphabetically ordered):

- 📞 little
- 📞 lovely
- 📞 old
- 📞 orange
- 📞 rectangular
- 📞 steel
- 📞 whittling
- 📞 Victorian

As in “something-something-...-something knife.”

## Vowel space fun times (ablaut reduplication):

- 📞 Tick-tock not tock-tick.
- 📞 Hip-hop not hop-hip.
- 📞 Bing-bong not bong-bing.
- 📞 Ping-pong not pong-ping.
- 📞 Flip-flop not flop-flip.
- 📞 Clip-clop not clop-clip (Onomatopoeia)
- 📞 Dilly-dally not dally-dilly.
- 📞 Pitter-patter not patter-pitter.
- 📞 Pitapat not patapat.
- 📞 Zig-zag not zag-zig.
- 📞 Om not Mo (A-U-M, back to front of the mouth).

John Conway's [Doomsday rule](#) [↗](#) for determining a date's  
day of the week:

## Memorable Doomsdays:

| Month     | Memorable date                                       | Month/Day    | Mnemonic <sup>(6)</sup>                     |
|-----------|--|--------------|---|
| January   | January 3 (common years), January 4 (leap years)     | 1/3 or 1/4   | the 3rd 3 years in 4 and the 4th in the 4th |
| February  | February 28 (common years), February 29 (leap years) | 2/28 or 2/29 | last day of February                        |
| March     | "March 0"  | 3/0          | last day of February                        |
| April     | April 4  | 4/4          | 4/4, 6/6, 8/8, 10/10, 12/12                 |
| May       | May 9  | 5/9          | 9-10-5 at 7-11                              |
| June      | June 6   | 6/6          | 4/4, 6/6, 8/8, 10/10, 12/12                 |
| July      | July 11  | 7/11         | 9-10-5 at 7-11                              |
| August    | August 8   | 8/8          | 4/4, 6/6, 8/8, 10/10, 12/12                 |
| September | September 5  | 9/5          | 9-10-5 at 7-11                              |
| October   | October 10   | 10/10        | 4/4, 6/6, 8/8, 10/10, 12/12                 |
| November  | November 7   | 11/7         | 9-10-5 at 7-11                              |
| December  | December 12  | 12/12        | 4/4, 6/6, 8/8, 10/10, 12/12                 |

- 📞 Pi day (March 14), July 4, Halloween, and Boxing Day are always Doomsdays.

## Outline:

- ☞ Determine “anchor day” for a given century, then find Doomsday for a given year in that century.
- ☞ Remember special Doomsday dates and work from there.
- ☞ Naturally: Load this year’s Doomsday into brain.

Century’s anchor day (Gregorian, Sunday  $\equiv$  0):

$$5 \times \left( \left\lfloor \frac{YYYY}{100} \right\rfloor \bmod 4 \right) \bmod 7 + \text{Tuesday}$$

Offset:

$$\left( 365YY + \left\lfloor \frac{YY}{4} \right\rfloor \right) \bmod 7 = \left( YY + \left\lfloor \frac{YY}{4} \right\rfloor \right) \bmod 7$$


| Doomsdays for the Gregorian calendar |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Mon.                                 | Tue. | Wed. | Thu. | Fri. | Sat. | Sun. | Mon. | Tue. | Wed. | Thu. | Fri. | Sat. | Sun. |
| 1898                                 | 1899 | 1900 | 1901 | 1902 | 1903 | →    | 1904 | 1905 | 1906 | 1907 | →    | 1908 | 1909 |
| 1910                                 | 1911 | →    | 1912 | 1913 | 1914 | 1915 | →    | 1916 | 1917 | 1918 | 1919 | →    | 1920 |
| 1921                                 | 1922 | 1923 | →    | 1924 | 1925 | 1926 | 1927 | →    | 1928 | 1929 | 1930 | 1931 | →    |
| 1932                                 | 1933 | 1934 | 1935 | →    | 1936 | 1937 | 1938 | 1939 | →    | 1940 | 1941 | 1942 | 1943 |
| →                                    | 1944 | 1945 | 1946 | 1947 | →    | 1948 | 1949 | 1950 | 1951 | →    | 1952 | 1953 | 1954 |
| 1955                                 | →    | 1956 | 1957 | 1958 | 1959 | →    | 1960 | 1961 | 1962 | 1963 | →    | 1964 | 1965 |
| 1966                                 | 1967 | →    | 1968 | 1969 | 1970 | 1971 | →    | 1972 | 1973 | 1974 | 1975 | →    | 1976 |
| 1977                                 | 1978 | 1979 | →    | 1980 | 1981 | 1982 | 1983 | →    | 1984 | 1985 | 1986 | 1987 | →    |
| 1988                                 | 1989 | 1990 | 1991 | →    | 1992 | 1993 | 1994 | 1995 | →    | 1996 | 1997 | 1998 | 1999 |
| →                                    | 2000 | 2001 | 2002 | 2003 | →    | 2004 | 2005 | 2006 | 2007 | →    | 2008 | 2009 | 2010 |
| 2011                                 | →    | 2012 | 2013 | 2014 | 2015 | →    | 2016 | 2017 | 2018 | 2019 | →    | 2020 | 2021 |
| 2022                                 | 2023 | →    | 2024 | 2025 | 2026 | 2027 | →    | 2028 | 2029 | 2030 | 2031 | →    | 2032 |
| 2033                                 | 2034 | 2035 | →    | 2036 | 2037 | 2038 | 2039 | →    | 2040 | 2041 | 2042 | 2043 | →    |
| 2044                                 | 2045 | 2046 | 2047 | →    | 2048 | 2049 | 2050 | 2051 | →    | 2052 | 2053 | 2054 | 2055 |
| →                                    | 2056 | 2057 | 2058 | 2059 | →    | 2060 | 2061 | 2062 | 2063 | →    | 2064 | 2065 | 2066 |
| 2067                                 | →    | 2068 | 2069 | 2070 | 2071 | →    | 2072 | 2073 | 2074 | 2075 | →    | 2076 | 2077 |
| 2078                                 | 2079 | →    | 2080 | 2081 | 2082 | 2083 | →    | 2084 | 2085 | 2086 | 2087 | →    | 2088 |
| 2089                                 | 2090 | 2091 | →    | 2092 | 2093 | 2094 | 2095 | →    | 2096 | 2097 | 2098 | 2099 | 2100 |

- ☞ Works for Gregorian (1582–, haphazardly) and the increasingly inaccurate Julian calendars (400 and 28 years cycles).
- ☞ Apparently inspired by Lewis Carroll’s work on a perpetual calendar.

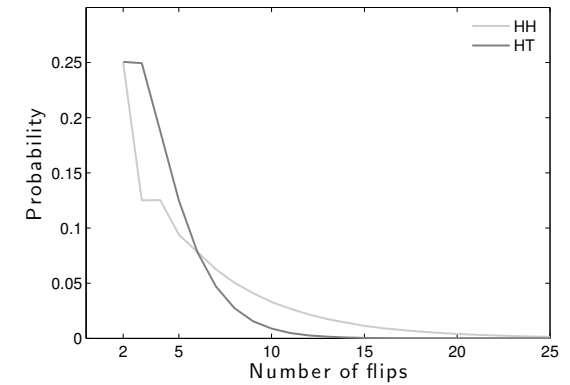
## The bissextile year

“The Julian calendar, which was developed in 46 BC by Julius Caesar, and became effective in 45 BC, distributed an extra ten days among the months of the Roman Republican calendar. Caesar also replaced the intercalary month by a single intercalary day, located where the intercalary month used to be. **To create the intercalary day, the existing ante diem sextum Kalendas Martias (February 24) was doubled, producing ante diem bis sextum Kalendas Martias. Hence, the year containing the doubled day was a bissextile (bis sextum, “twice sixth”) year.** For legal purposes, the two days of the bis sextum were considered to be a single day, with the second half being intercalated; but in common practice by 238, when Censorinus wrote, the intercalary day was followed by the last five days of February, a. d. VI, V, IV, III and pridie Kal. Mart. (the days numbered 24, 25, 26, 27, and 28 from the beginning of February in a common year), so that the intercalated day was the first half of the doubled day. Thus the intercalated day was effectively inserted between the 23rd and 24th days of February.”

## Homo nonprobabilisticus, continued:


- ☞ Important detour: The final digits of primes are not entirely random  (how did we not know this?).
- ☞ Start flipping a coin ...
- ☞ Two tosses: What are the probabilities of flipping (1) *HH* and (2) *HT*?
- ☞ Flip a coin  $n \geq 2$  times: What are the probabilities that the last two tosses are (1) *HH* or (2) *HT*?
- ☞ Estimate: On average, how many flips does it take to first see the sequence *HT*?
- ☞ Estimate: On average, how many flips does it take to first see the sequence *HH*?
- ☞ What’s the probability of first flipping a *HT* sequence on the  $n - 1$ th and  $n$ th flips?
- ☞ What’s the probability of first flipping two heads in a row (*HH*) on the  $(n - 1)$ th and  $n$ th flips?

## Homo nonprobabilisticus, continued:



Average number of flips: 4 and 6.

## References I

- [1] K. E. Hubbard and S. D. Dunbar. Perceptions of scientific research literature and strategies for reading papers depend on academic career stage. *PLOS ONE*, 12:e0189753, 2017. [pdf](#) 
- [2] C. Stewart. Haud Immemor: Reminiscences of Legal and Social Life in Edinburgh and London, 1850-1900. W. Blackwood & sons, 1901.