LIOUVILLE'S CONSTANT

$$L = \sum_{k=1}^{\infty} \frac{a_k}{b^{k!}} \quad \text{where } \boxed{\begin{array}{l} b = 10 \\ a_k = 1 \end{array}} \text{ for all } k$$

$\{1..10\}$ (DECIMAL SYSTEM?)

RULE: k^{th} term is the $(k!)^{th}$ place in the decimal sequence

$L = 0.110001000000000000000000001\ldots$

$1!^{th}$ (1·1!) 1st; $2!^{th}$ (2·1!) 2nd; $3!^{th}$ (3·2!) 6th; $4!^{th}$ 4·3! 24th

$\ldots000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000$
$000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000\ 000$
$000\ 000\ 000\ 00\ \mathbf{1}\ 000\ldots000\ \mathbf{1}\ \ldots\ \mathbf{1}$

$5!^{th}$ (5·4!) 120th; $6!^{th}$ 720th; $\infty!^{th}$ $[\infty\cdot(\infty-1)!]$ infinity-th [[(w/in $\mathbb{N}$ ONLY) ((of course))]...

JOKE

$\mathbb{R}$ (base b representation) 1001001011010

MULTIPLE INFINITIES
CARDINALITIES OF INFINITY
CANTOR, GEORG

$\mathbb{Z}$ integers
transcendentals
complex nums
$e^{\pi i}$

the reals escape! $\mathbb{R}$

BIG OLD CLOCK SIGNAL!

TABLE OF SYMBOLS:

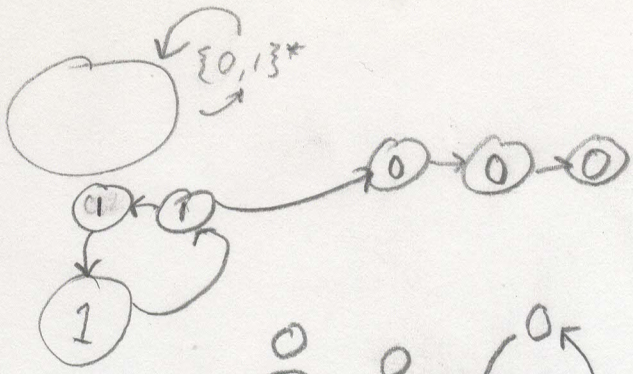
$[] = \mathbb{N}$ - BOUNDED INF

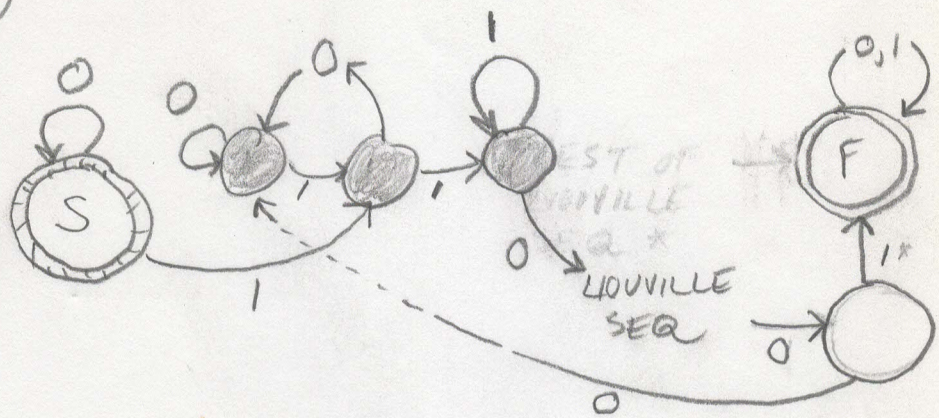
$() = \mathbb{R}$ - BOUNDED INF

$-1 = e^{\pi i} = \mathbb{Z}$ INTEGERS (LOOPS)

L = *MOST *NUM OF LOWEST COMMON FACTORS $\mathbb{P}$ PRIME BETWEEN CLOCK SIGNALS ((STRANGE ONES, TOO))

TIME!





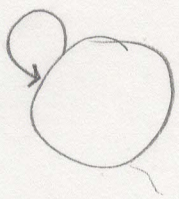
*FINAL 1 IN

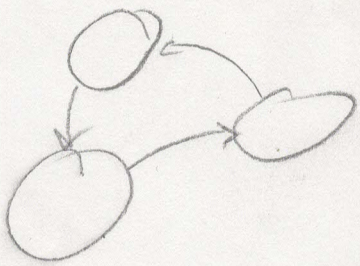
(G)

.110001

$$.11\overset{3}{0}1\overset{17}{0}1\overset{95}{0}10$$

$1!\ 2!\ 3!\ 4!\ 5!$





$2^3 = 8$
$3^2 = 9$
$4^2 = 16$
$4^3 = 64$
$5^2 = 25$
$5^3 = 125$
$6^2 = 36$
$6^3 = 216$

$$\lim_{\substack{n\to 1 \\ m\to 0}} \frac{-Le^{n^m}}{\Delta^{w^v}} = \frac{-Le^{m^n}}{\Delta^{v^w}} \qquad n\in\mathbb{N},\ m\in\mathbb{R}\setminus\mathbb{N}$$

$w, v \in \mathbb{P}$ s.t. $w \geq 2 > v > 1$

the question you expect (numbers)

digits $\mathbb{N} = \{0 .. \infty\}$

numbers $\mathbb{R} = \{0, \{0.\bar{0}1 .. 0.\bar{9}\}, 1, \{1.\bar{0}1 .. 1.\bar{9}\}, 2, \ldots \infty\}$

∞

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stjude.org/donatetoday

$0.\overline{0123456789} = \frac{13717421}{111\ 111\ 111}$

$0.\overline{0987654321} = \frac{109739369}{111\ 111\ 111}$

8 < 0.0123456789, 0.0987654321 { ∞ ∞ ∞

$0.\overline{123456789} = \frac{13717421}{111\ 111\ 111}$

$0.\overline{987654321} = \frac{109739369}{111\ 111\ 111}$



2....
21...
22...
23...
24...
.....
∞.....

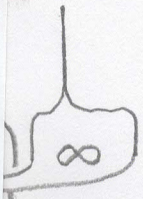
1/30/23



digits $\mathbb{N}$

numbers $\mathbb{R}$

$\{1..1.\bar{9}\}, 2, \ldots \infty\}$



2...
3...
4...
5...
6...
7...
8...
9...
10...
11...
12...
13...
14...
15...
16...
17...
18...
19...
20...
21...
22...
23...
24...
.....
∞.....

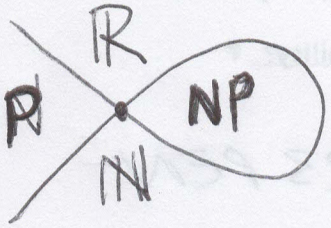
1/30/23

$\mathbb{N}$ = SET OF NATURAL NUMBERS

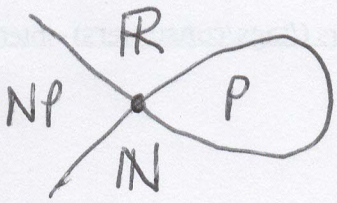
$\mathbb{R}$ = SET OF REAL NUMBERS

P = PROBLEMS THAT CAN BE VERIFIED IN POLYNOMIAL TIME

NP = PROBLEMS THAT MUST BE VERIFIED IN NONDETERMISTIC POLYNOMIAL TIME



OR



• = {0123456789}

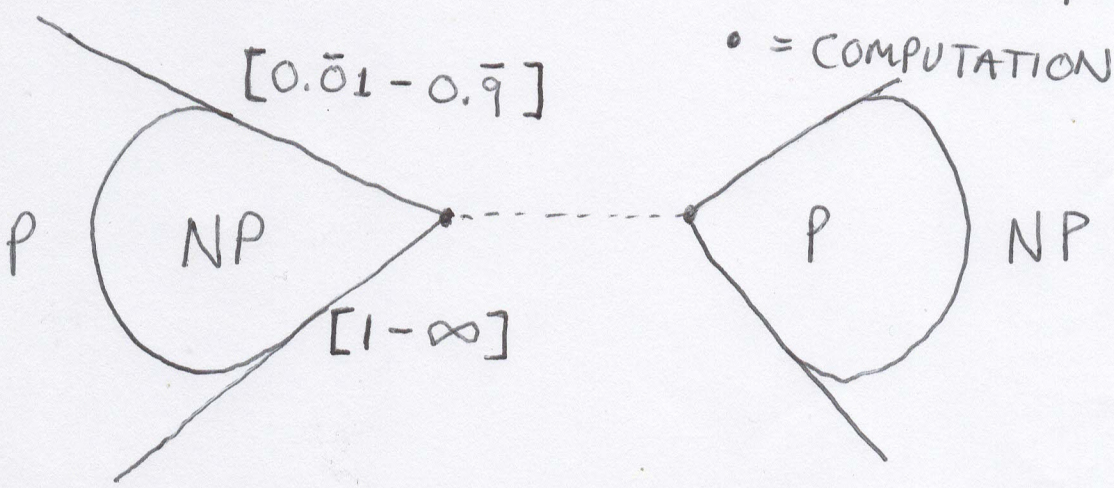
• = SET OF 10 DIGITS

• =

0	0 = 0
10	1 = 1
1	2 = 10
100	3 = 11
101	4 = 100
110	5 = 101
	6 = 110
	7 = 111
	8 = 1000
	9 = 1001

• = $\mathbb{N} \cap \mathbb{R} \cap P \cap NP$

• = COMPUTATION



THERE IS A FINITE NUMBER OF COMPLEXITY CLASSES TO DESCRIBE EVERY NP PROBLEM IN P.

THERE IS NO FINITE NUMBER OF COMPLEXITY CLASSES TO DESCRIBE EVERY P PROBLEM IN NP.

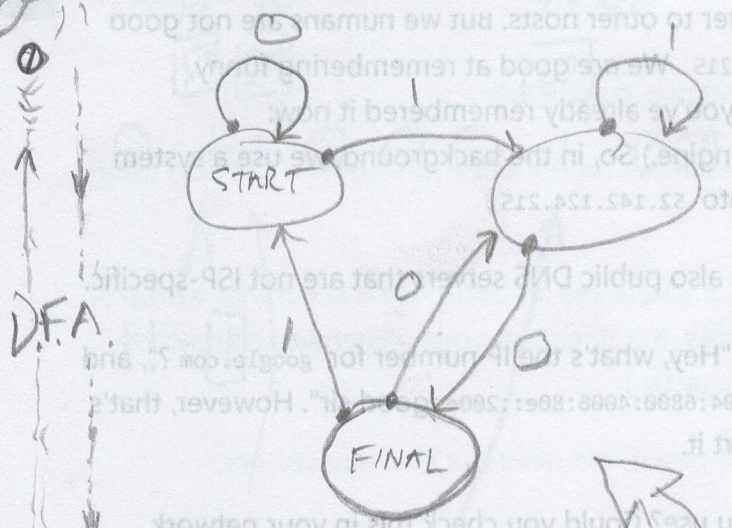
START

← CHUCK'S REASONING

PING...

OVER ALPHABET {0, 1}

2/5/23



D.F.A.

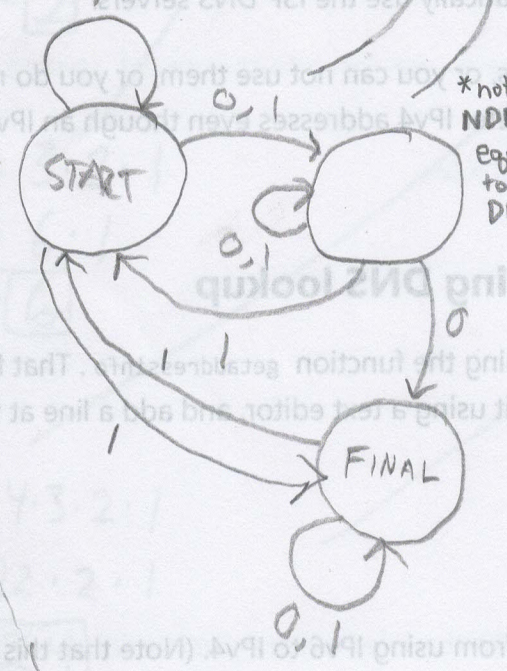
DFA = DETERMINISTIC FINITE AUTOMATON

NDFA = NONDETERMINISTIC FINITE AUTOMATON

P vs. NP

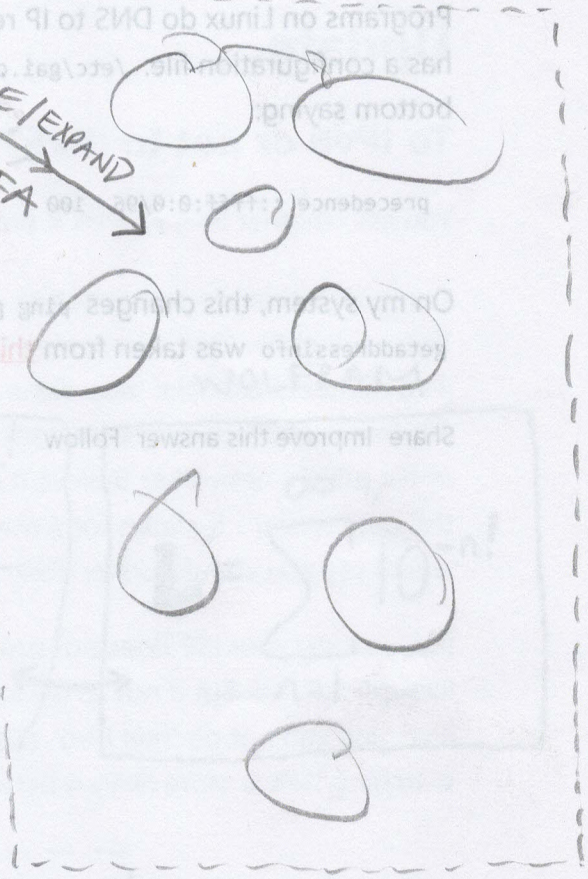
HOW LONG DOES IT TAKE TO REDUCE AN NDFA TO A DFA?

N.D.F.A.

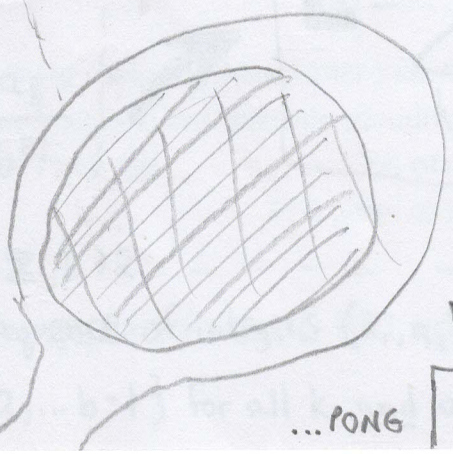


*note: this NDFA is not equivalent to that DFA

REDUCE/EXPAND TO A DFA



EDGE OF PAPER (FINAL)



...PONG

← CHUCK'S REASONING

L = LIOUVILLE'S CONSTANT

1st 2nd 3rd ONE= 4th 5th

1st | 2nd | 6th | 24th | 120th

$0.1100\,0001\,000\,000\,000\,000\,000\,001\ldots$

$1! = 1$

$2! = 2 \cdot 1 = 2$

$3! = 3 \cdot 2 \cdot 1 = 6 \cdot 1 = 6$

$4! = 4 \cdot 3 \cdot 2 \cdot 1 = 12 \cdot 2 \cdot 1 = 24$

$5!$

$$X = \sum_{k=1}^{\infty} \frac{a_k}{b^{k!}}$$

where $b \in \mathbb{Z}, b \geq 2$

a_k is any sequence of integers $(a_1, a_2, a_3, \ldots)$ such that

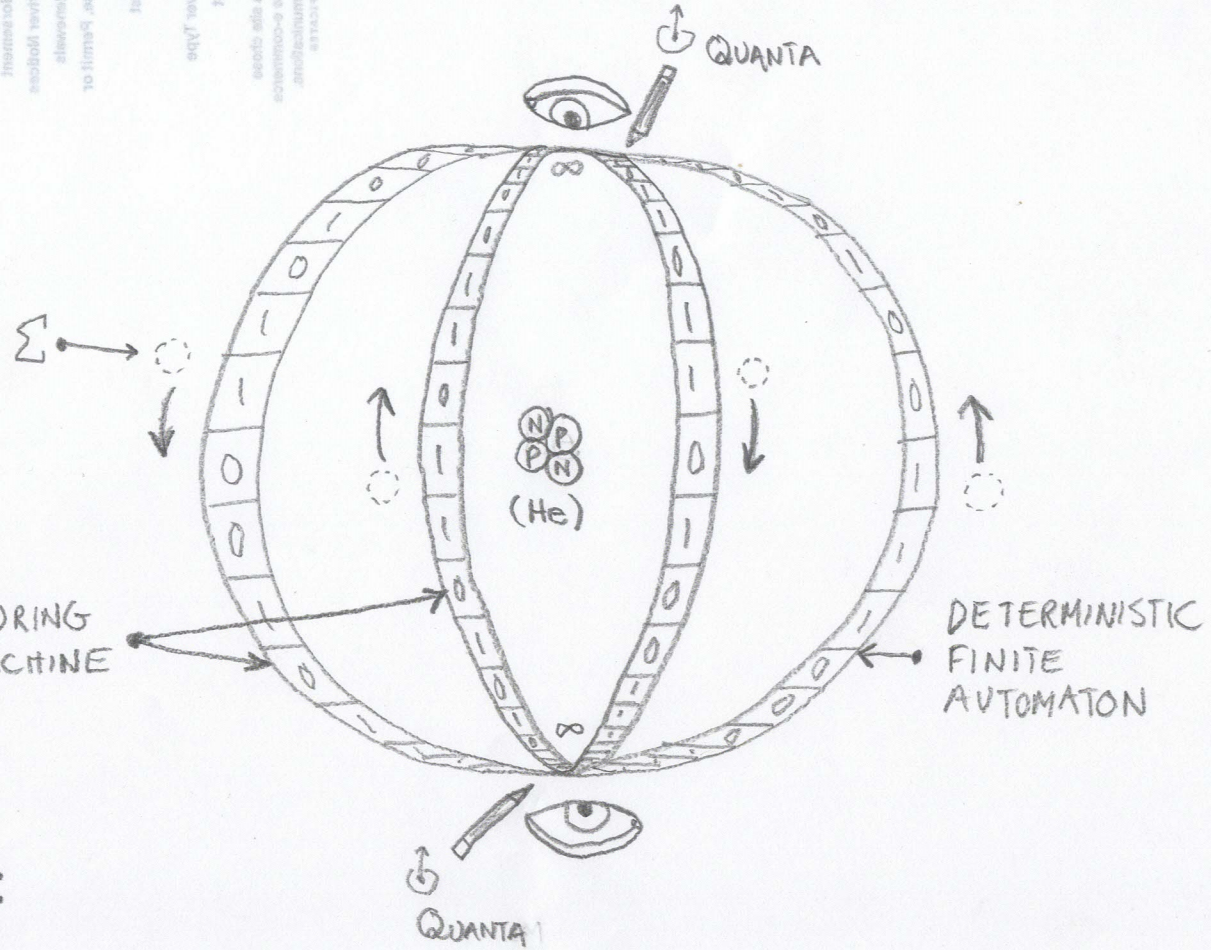
$a_k \in \{0, 1, 2, \ldots b-1\}$ for all k and $a_k \neq 0$ for infinitely many k

WIKIPEDIA

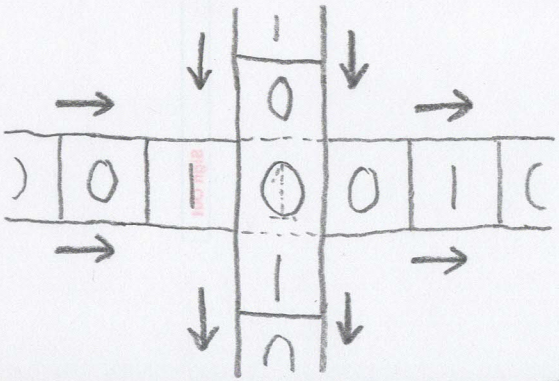
$$L = \sum_{k=1}^{\infty} \frac{1}{10^{k!}} \qquad a_k = 1 \quad b = 10$$

WOLFRAM

$$L = \sum_{n=1}^{\infty} 10^{-n!}$$



EYE VIEW:



$\sum$ = ELECTRONS

(ALPHABET)