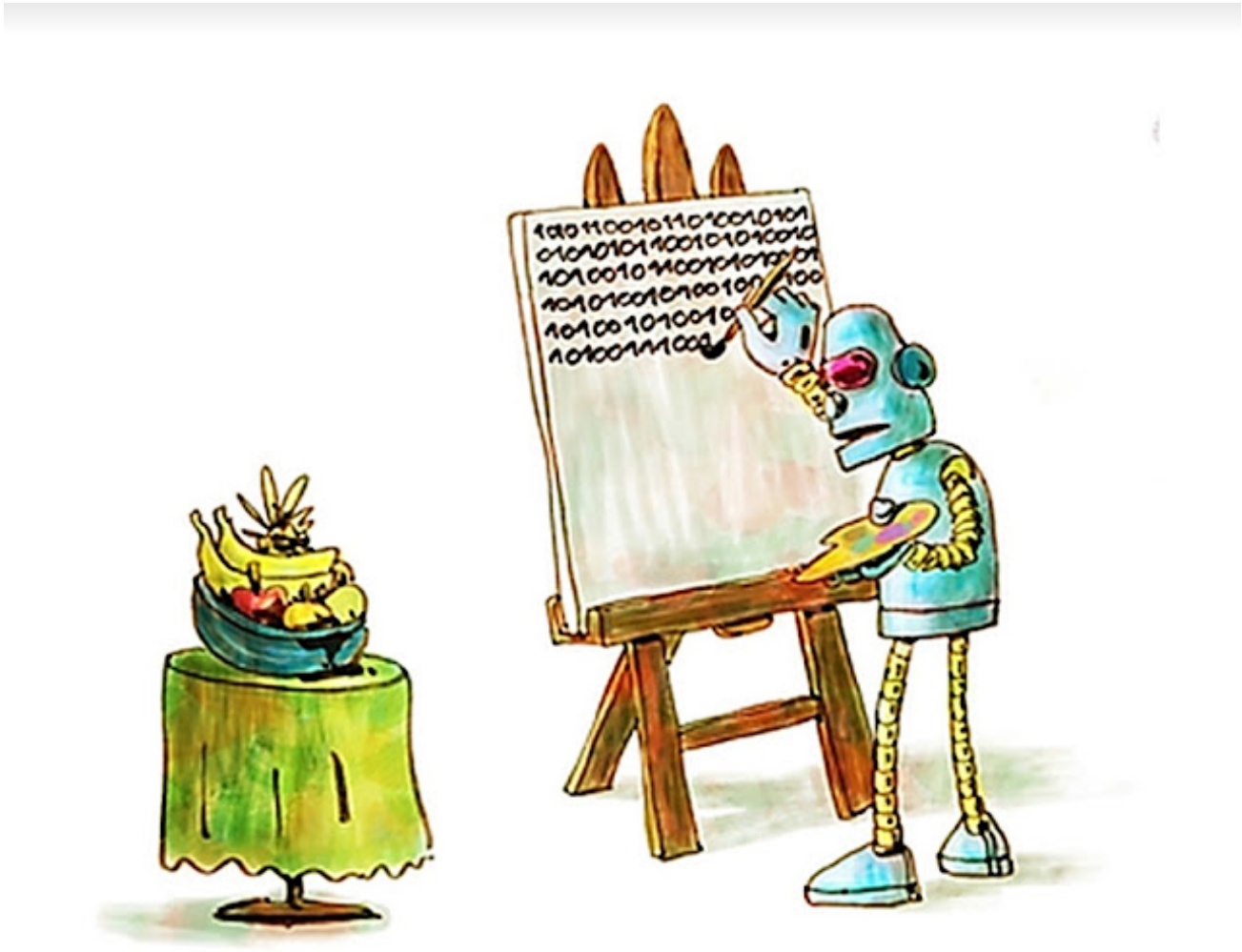
Cinquante signes

Does this iteration end? (Sum and erase)

juillet 26, 2022



Does this iteration end?

The procedure is easy to understand; we take any integer N (for example N = 1124), make

the sum S of its digits (S = 8 here) and concatenate S at the end of N (we get 11248).

We iterate from there until the leftmost digit *d* of N appears in S: we then erase all *d*'s of the last concatenation – and start from there a new iteration.

Example:

1124

11248

1124816 (hit: the digit *d* = 1 appears in S = 16)

2486 (we have erased all 1s of the last concatenation)

248620 (hit again: the digit *d* = 2 appears in S = 20)

4860 (we have erased all 2s of the last concatenation)

486018

48601827

4860182736...

Wait, what happens if we bump into a leading zero? Let's go on with our example to see the rule:

48601827645 (hit: the digit *d* = 4 appears in S = 45)

8601827365

860182736546

86018273654656

8601827365465667

860182736546566780 (hit: the digit *d* = 8 appears in S = 80)

601273654656670

60127365465667064 (hit: the digit *d* = 6 appears in S = 64)

01273545704 (we have now a leading zero)

Rule: we leave the above *string* as it is and iterate from there, as we've done so far (the leading zero will appear at some point in some S)

0127354570438

012735457043849

01273545704384962

012735457043849670 (hit: the digit *d* = 0 appears in S = 70)

1273545743849627

Etc.

You've certainly noticed that the starting N of the above example (N = 1124) is nothing else but the beginning of the sequence starting with N = 11.

As all the sequences that start with 0 < N < 11 end almost immediately (N = 10, 101, 0), we could ask ourselves if the sequence produced by N = 11 ends at some point? Grows forever? Loops? Vanishes?

Forgive, as always, the typos left in this message/computations; I hope the idea is clear.

Best,

É.

Update, a couple of hours after this was sent to Math-Fun:

[**Michael Branicky**]:

> Eric, I get it ending in the empty string after 1399142 steps

[**Me**]:

> Waooooow, Michael!
> I'm k.o.!
> Do you still have the longest string of yr computation?
> And what about another start (like N = 12)
> (no, just kidding!-)
> Best,
> É.

[**Michael**]:

> Eric,

> starting at "11", the longest string encountered:
444444414144444541444441454544551551545455154545647565175555456576766644656777675961617616416561527541551562575592651853254255356658359962263264365667368971272273374676377982812823836853869892911922935952968991101010121016
(length 222)

>"12" ends at step 384831

>See
https://colab.research.google.com/drive/1LtQlt32jYCRBo8LOE5-RmZb-FEYZrAug
for link to Python Notebook

>Cheers,

>Michael

[**Hans Havermann**]:

>> [Eric asks]: "Do you still have the longest string of yr computation?"

> I guess we can both check this against Michael's response. :) At step 1011800 we have the length-222 string:

444444414144444541444441454544551551545455154545647565175555456576766644656777675961617616416561527541551562575592651853254255356658359962263264365667368971272273374676377982812823836853869892911922935952968991101010121016

[**Hans** to Eric]:

> "At step 1011800 we have the length-222 string"

I didn't know we were starting with "11" (I started with "1124"). So it is at step 1011802. That explains my difference of 2 for the total number of steps before reaching the empty string

[**Hans**, exploring this idea further]:

> The smallest number that does not disappear is 25.

```
step # 0 = 25
step # 1 = 257
step # 2 = 25714
step # 3 = 2571419
step # 4 = 5714199
step # 5 = 571419936
step # 6 = 714199364
step # 7 = 71419936444
step # 8 = 7141993644452
step # 9 = 714199364445259
step #10 = 141993644452593
... step #209860 = 866908898496111114120123129141147191391521601 67
    step #209861 = 669094961111141201231291411471913915216016711
... step #776829 =
757744754759744439337494793339337339354333933731738341349353373535 8
374388474184314394554694885851481494511518532542553566583599622632 6
436566736897127227337467637798281282383685386989291192293595296899 1
10101012101610241031103610 46
... step #793652 = 866889098496111114120123129141147191391521601 67
    step #793653 = 669094961111141201231291411471913915216016711
```

The string at #209861 repeats at #793653 (but from a different precursor), creating a loop of length 583792. #776829 gives the maximum, which will of course repeat at #776829+583792n for positive n.

[**Hans** again, a couple of hours later on *Math-Fun*]:

http://cinquantesignes.blogspot.com/2022/07/does-this-iteration-end-sum-and-erase.html

Eric's procedure appears to mostly vanish small starting integer strings but there are cycles: 25, 31, 63, 67, 69, 77, 92, 96, 99, 105, 109, 116, 133, 138, 148, 152, 161, 162, 163, 168, 174, 194, 197, 198, 206, ... run into them, or rather into it, since it's always the same length-583792 cycle, call it c3374 after its shortest string. Can anyone find any other cycle?

... Beautiful discovery, **Hans**, many thanks!

See hereunder how an integer like 282 vanishes:

step #0 = 282
step #1 = 28212 (hit: the digit d = 2 appears in S = 12)
step #2 = 81
step #3 = 819
step #4 = 81918 (hit: the digit d = 8 appears in S = 18)
step #5 = 191
step #6 = 19111 (hit: the digit d = 1 appears in S = 11)
step #7 = 9
step #8 = 99 (hit: the digit d = 9 appears in S = 9)
step #9 = .. (vanishes)

The same 9-step vanishing would happen with 228, of course – but not with 822...

(to be continued?)

Yes! **Hans** wrote another couple of hours later:

[**Hans**]:

"... it's always the same length-583792 cycle, call it c3374 after its shortest string. Can anyone find any other cycle?"

I didn't think that there would be any short cycles, but I did find one: length-49, c5464644657500000011711019071641751. Here's how it goes:

step #0 = 5464644657500000011711019071641751

step #1 = 54646446575000000117110190716417511 09

step #2 = 546464465750000001171101907164175110 9119

step #3 = 5464644657500000011711019071641751109119130

step #4 = 54646446575000000117110190716417511091191 30134

step #5 = 546464465750000001171101907164175110911913013 4142

step #6 = 5464644657500000011711019071641751109119130134142149

step #7 = 54646446575000000117110190716417511091191301341421491 63

step #8 = 546464465750000001171101907164175110911913013414214916 3173

step #9 = 5464644657500000011711019071641751109119130134142149163173184

step #10 = 54646446575000000117110190716417511091191301341421491631731841 97

step #11 = 546464465750000001171101907164175110911913013414214916317318419 7214

step #12 = 546464465750000001171101907164175110911913013414214916317318419 7214 221

step #13 = 546464465750000001171101907164175110911913013414214916317318419 7214 221226

step #14 = 546464465750000001171101907164175110911913013414214916317318419 7214 221226236

step #15 = 546464465750000001171101907164175110911913013414214916317318419 7214 221226236247

step #16 = 546464465750000001171101907164175110911913013414214916317318419 7214 221226236247260

step #17 =
5464644657500000011711019071641751109119130134142149163173184197214
221226236247260268
step #18 =
54646446575000000117110190716417511091191301341421491631731841972142
22122623624726026 8
step #19 =
54646446575000000117110190716417511091191301341421491631731841972142
2212226362472602682842 98
step #20 =
54646446575000000117110190716417511091191301341421491631731841972142
22122623624726026828429 8317
step #21 =
54646446575000000117110190716417511091191301341421491631731841972142
221226236247260268284298317328
step #22 =
54646446575000000117110190716417511091191301341421491631731841972142
2212226362472602682842983173283 41
step #23 =
54646446575000000117110190716417511091191301341421491631731841972142
22122623624726026828429831732834 1349
step #24 =
46464467000000117110190716417110911913013414214916317318419721422 12
26236247260268284298317328341349 36
step #25 =
66670000001171101907161711091191301312191631731819721221226236272 60
2682829831732831393635
step #26 =
70000001171101907117110911913013121913173181972122122327202828298 3
17328313933530
step #27 =
70000001171101907117110911913013121913173181972122122327202828298 3
173283139335302 49
step #28 =

700000011711019071171109119130131219131731819721221222327202828298317328313933530249264

step #29 =

000000111101901111091191301312191313181921221222322028282983132831393532492642622824246258273285300303309

step #30 =

0000001111019011110911913013121913131819212212223220282829831328313933530249264262282424625827328530033093

step #31 =

1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #32 =

1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #33 =

1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #34 =

1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #35 =

1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #36 =

1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #37 =

1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #38 =

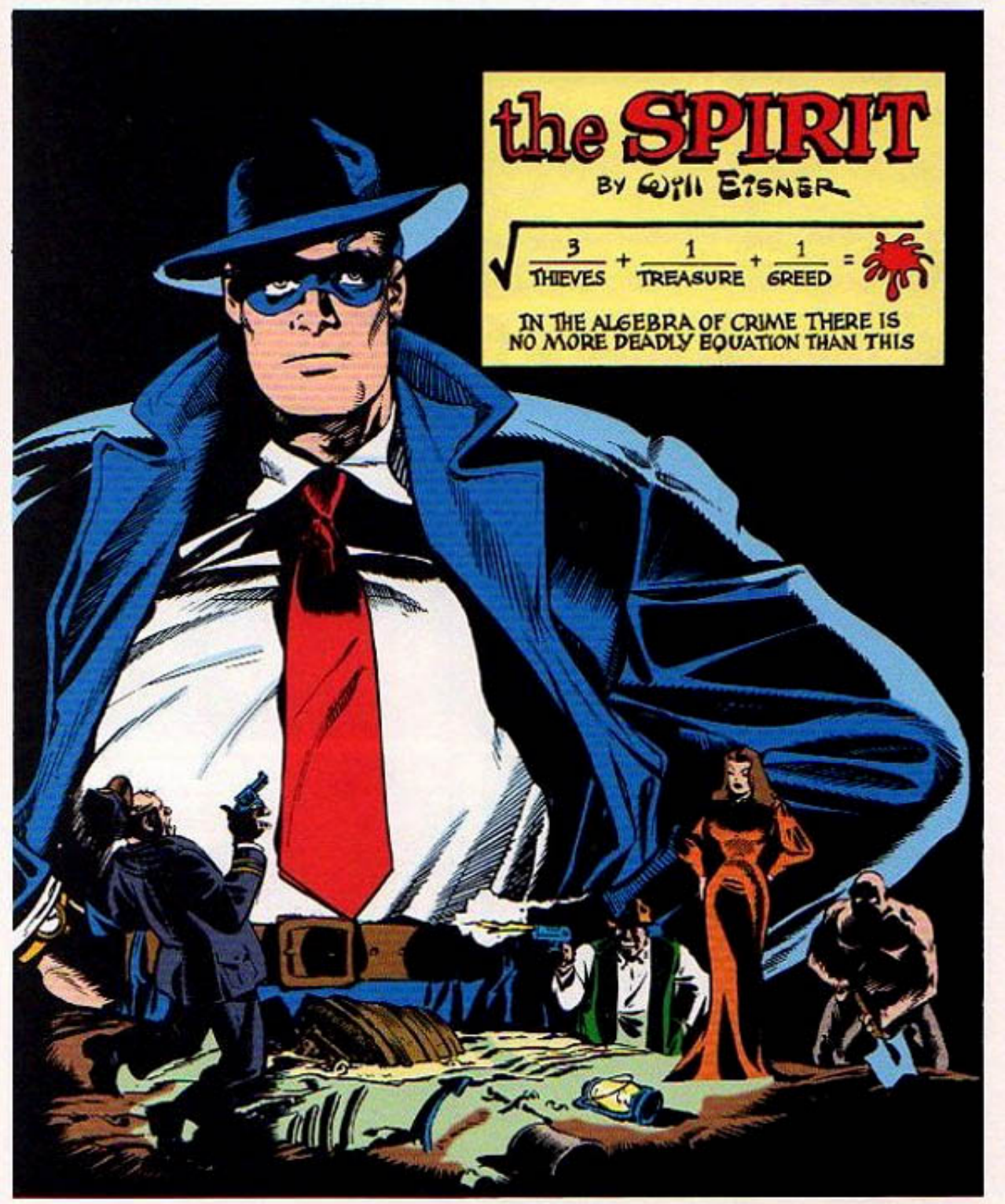
1111191111911913131219131318192122122232228282983132831393532492642622824246258273285300303309

step #39 =

9993329338922222232228282983328339335324926426228242462582732853003

```
0330932
step #40 =
99933293389222222322282829833283393353249264262282424625827328530030330
0330932303
step #41 =
33233822222232228282833283333532426426228242462582732853003033032303
330
step #42 = 28222222222828282852426426228242462582728500002021
step #43 = 282222222228282828524264262282424625827285000020021171
step #44 =
2822222222282828285242642622824246258272850000200211711 80
step #45 =
28222222222828282852426426228242462582728500002002117118018 9
step #46 = 888885464684465878500000011711801890 7
step #47 = 8888854646844658785000000117118018907164
step #48 = 88888546468446587850000001171180189071641 75
step #49 = 5464644657500000011711019071641751
```

Bravo and *merci* to **Michael** and **Hans** — both of you kill!
(this is now A359143)


the SPIRIT
BY Will Eisner
$\sqrt{\frac{3}{\text{THIEVES}} + \frac{1}{\text{TREASURE}} + \frac{1}{\text{GREED}}} =$
IN THE ALGEBRA OF CRIME THERE IS NO MORE DEADLY EQUATION THAN THIS

MFH *2 septembre 2022 à 10:04*

In case s/o is interested, here are "minimal representatives" of some more cycles I've found, and their length or size (number of elements in the cycle): 332 (size: 14072) ; 0999 (size: 624885) ; 3374 (size: 583792) ; 3933 (size: 10537) ; 083433 (size: 120621) ; 222227222772202078 (size: 1723) ; 5464644657500000011711019071641751 (size: 49, the one found by Hans).

RÉPONDRE

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A square for three (chess)

juin 22, 2024

(English translation after the French text) Voici cinq problèmes d'échecs disjoints : a) combien faut-il de coups au minimum pour que trois pions soient capturés sur la même case ? b) trois tours c) trois c ...

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Le tripalin se présente

avril 11, 2024

Un tripalin est constitué de trois images. Chaque image illustre un substantif. Accolés, ces trois substantifs forment une chaîne palindromique. Laquelle nous vous invitons à trouver. Exem ...

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Some strings au cinéma Galeries

juillet 19, 2024

Lettre ouverte au cinéma Galeries Bonsoir à tous, Je viens de voir pour la seconde fois chez vous le beau film de Léos Carax (la première fois c'était le 26 juin en présence du réalisateur, au BRIFF). Apparut à l'écran aujourd'hui, avant la projection propre ...

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Archiver

Signaler un abus