

Une suite pour la Vie

(doublée d'une correspondance passionnante avec **Dean Hickerson**)

Une suite de nombres en rapport avec le [Jeu de la Vie](#) : celle de ceux qui *disparaissent* quand on leur soumet la loi d'airain des naissances et des morts. Pour trouver ces nombres, il faut d'abord en fixer l'aspect. Voici l'alphabet retenu, il se compose des dix chiffres obtenus en noircissant les cases *ad hoc* d'un rectangle 3 x 5 :

```

xxx  x  xxx  xxx  x x  xxx  xxx  xxx  xxx  xxx
x x  x  x  x  x x  x  x  x x  x x
x x  x  xxx  xxx  xxx  xxx  x  xxx  xxx
x x  x  x  x  x  x  x x  x  x x  x
xxx  x  xxx  xxx  x  xxx  xxx  x  xxx  xxx

0  1  2  3  4  5  6  7  8  9

```

On séparera d'une case les chiffres à l'intérieur des nombres, puis on les injectera dans une *applet* du type de celle qui figure en bas de page. Le résultat, après quelques générations, est toujours l'un des trois suivants :

- disparition de la population de départ ;
- croissance infinie (par dissémination de vaisseaux, par exemple) ;
- stabilisation.

Pour le cas qui nous occupe - le *devenir* des nombres -, tout dépend de la typographie utilisée, bien sûr. Nous avons dessiné les chiffres du haut de la manière la plus courante possible (*cf.* les divers affichages digitaux, pendulettes, réveils-matin, lecteurs de DVD, etc.) - mais d'autres façons de faire sont envisageables, lesquelles produiront d'autres résultats. Voici plusieurs dessins du 1, du 4 ou du 7 (nous avons retenu le 1b, le 4c, le 7b) :

```

xx  x  x  x  xx  xxx  xxx
x  x  x x  x  x x  x  x
x  x  xxx  x x  xxx  xx  x
x  x  x  xxx  x  x  x
xxx  x  x  x  x  x  x

1a  1b  4a  4b  4c  7a  7b

```

Les nombres qui disparaissent selon la graphie fixée tout en haut, sont :

8,10,11,14,18,20,31,48,50,81,83,87,88,101,118,122,127,144,148,155,157,161,174,181,188,191,199,202,205,206,20...

Cette suite est-elle finie ? Il est en effet concevable qu'elle s'arrête à partir d'un certain nombre, très grand, lequel ferait « exploser » la population initiale de points, envoyant des vaisseaux dans tous les sens, produisant des kyrielles de clignotants ou de blocs fixes - mais ne s'effondrant plus jamais sur elle-même...

Dean Hickerson, de la liste *SeqFan*, a montré qu'il n'en est rien et qu'il y aura toujours moyen de prolonger la suite et de trouver des nombres qui disparaissent.

Eric Angelini asked:

```

> If we represent the ten digits like this (in a 5x3 box):
...
> ... the integers which disappear in the "Game of Life" are listed hereafter
> (two digits, inside an integer, are always separated by one space):
>
> 8,10,14,18,20,31,48,50,81,83,87,88,101,118,122,127,144,148,155,157,161,174,
> 181,188,191,199...
>
> Is the sequence finite?

```

No. For example, numbers of the form 1811...1181 all die in 5 generations.

Just to clarify, we're using a variable width font, with "1" being narrower than the other digits; e.g. 1811181 is:

```

o ooo o o o ooo o
o o o o o o o o o
o ooo o o o ooo o
o o o o o o o o o
o ooo o o o ooo o

```

But even if we use a fixed-width font, the same numbers (starting with 181181) still die, in 15 gens:

```

o ooo o o o ooo o
o o o o o o o o o
o ooo o o o ooo o
o o o o o o o o o
o ooo o o o ooo o

```

(Of course, I don't think this sequence should be added to OEIS, since

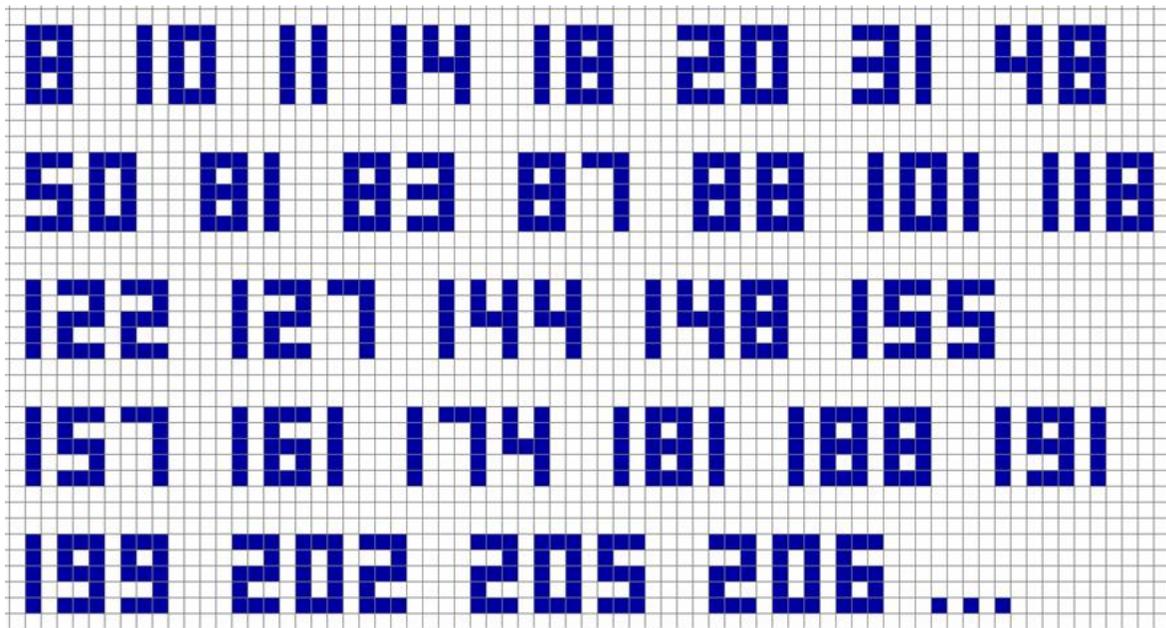
it depends not only on base-10 representations, but also on a specific way of representing digits as Life patterns.)

Dean Hickerson

De même que les nombres découverts par Dean (placer autant de « 1 » qu'on veut entre les bornes 1811 et 1181), il y a ceux qui commencent par « 1 » et qu'on fait suivre d'autant de « 4 » que l'on veut (14, 144, 1444, 14444...) - ils s'évanouissent aussi, mais en 9 générations à chaque fois.

L'applet utilisée pour produire image et suite est ici :

<http://www.math.com/students/wonders/life/life.html>



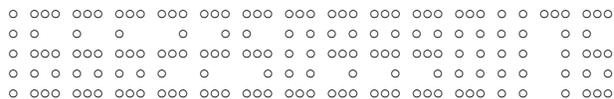
[Dernière minute : [Jonathan Post](#) vient de m'écrire ceci en privé (7 février 2007)

(...)
By the way, Eric, I first did the lower end of your sequence 39 years ago in 1968 at Caltech in a language called CITRAN (derived from JOSS) running on dumb terminals connected to an IBM 7090/7094 which did ALL the computing for all departments of Caltech plus NASA JPL!
(...)

... les beaux esprits se rencontrent !]

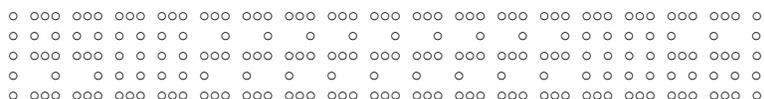
[Dernière seconde : **Dean Hickerson** revient sur la question de la durée de vie des *nombres-qui-meurent* :

Eric, I've thought some more about about numbers whose corresponding Life patterns die. The numbers listed on your web page all die within 65 generations. I wondered if there were numbers which take longer than that. After quite a bit of experimentation, I found that there's no limit on the length of time before such a pattern dies. In particular, the pattern for 1666225099901176 produces 2 gliders, which annihilate each other in generation 77:



If you change the '999' to a longer string of '9's, the lifetime increases; each additional '9' increases it by 8 generations.

I've tried to find a more interesting example, based on a decaying fuse formed by a string of '2's. But the best I've found doesn't quite die; it ends up with a population of 44. This happens for numbers of the form 19900222...22200661, where the number of '2's a multiple of 3 and >= 9. (If you add one more '2', you end up with two blocks and two period-3 pulsars.)



les nombres sont simples à expédier par courriel] :

>> The good thing with this is that *numbers* are easy
>> to post and to reproduce in an applet.

True, but for any really serious Life experiments you need a faster program, which can read and write patterns. Then you can run some of the larger patterns that people have built, like the ones on my Life page:

<http://www.math.ucdavis.edu/~dean/life.html>

>> Doesn't the Game of Life "sleep" a bit nowadays?

There are still several people who are active in Life. Most of us have other things that keep us busy, so activity is sporadic. (...) You can see some of the recent results on **H. Koenig's** blog:

<http://pentadecathlon.com/lifeNews/index.php>

>> This would wake a few people up, I guess!

Maybe. But, although your number patterns provide some fun puzzles, and I've enjoyed playing around with them for a while, they're not really relevant to the big questions in Life, like:

--> What oscillator periods are possible? (Currently we have examples of all periods except 19, 23, 31, 34, 37, 38, 41, 43, 51, and 53.) See **Jason Summers's** Game of Life Status page:

<http://entropymine.com/jason/life/status.html>

--> What spaceship velocities are possible? (Currently known: orthogonal $c/2$, $c/3$, $c/4$, $c/5$, $2c/5$, $c/6$, $2c/7$, $17c/45$; diagonal $c/4$, $c/5$, $c/6$, $c/12$) See Jason's page for this also.

--> What growth rates can we construct? (Currently known includes population in gen t asymptotic to a constant times t^r for any rational number r with $1 \leq r \leq 2$. Also for $r = 1/(2^k)$ with $k \geq 0$, $r = (k-1)/k$ with $k \geq 1$, and $r = 1/3$. Also $\log(t)$, $t \log(t)$, $\log(t)^2$, $t \log(t)^2$. (I'm sure I've forgotten some.)

--> Is there a pattern which has a parent but no grandparent? (I.e. it can occur in gen 1 of something, but not in gen 2.) **Conway** offered \$50 for this back around 1970, but it's still unanswered.

--> Can all still-lives and oscillators be constructed by crashing gliders together? See **Mark Niemiec's** Life Page:

<http://home.interserv.com/~mniemiec/lifepage.htm>

--> What is the ultimate fate of an infinite random pattern? Does it fill up with an ecosystem of competing self-replicators? What is its limiting density (if it has one)?

(...)

Here are the numbers up to 1000:

```

8 10 11 14 18 20 31 48 50 81 83 87 88 101 118 122 127 144 148 155 157
161 174 181 188 191 199 202 205 206 208 218 221 222 228 245 247 248 274
278 284 285 295 302 304 305 308 309 312 313 315 323 327 331 342 349 353
397 414 418 428 472 481 488 502 505 508 518 527 551 555 558 562 582 629
639 660 661 706 714 726 727 746 751 753 758 759 772 777 796 802 805 811
812 814 815 818 822 823 853 855 872 881 902 906 916 917 923 947 956 971

```

>> Thanks again, **Dean**, my right thumb is almost dead (entering
>> the applet lots of numbers via the mouse!)

If you switch to a Life program that can read and write pattern files in **RLE** notation (the most common one used for exchanging patterns), then you won't have to use the mouse so much.

>> wouldn't it be interesting to find the smallest integer producing:
>>
>> - a pure glider
...

Here, I think, are the smallest numbers which produce some of the small, named objects. In some cases there are smaller numbers that produce these along with other things, but these are probably the smallest that produce just a single object. (I only checked patterns that finish within 2000 gens. It's possible that there are smaller numbers which produce single objects after more than 2000 gens, but it's unlikely; patterns that last that long are usually large and messy.)

aircraft carrier	186176
bakery	1672
barge	243
beacon (p2)	3671
beehive	163
blinker (p2)	29
block	70
boat	24
clock (p2)	unknown
eater	1415073803975114
fleet	7108
glider	90
honey farm	78

HWSS	unknown
LWSS	3207
MWSS	94174
infinite grow	154299
loaf	60
long barge	unknown
long boat	587
long ship	unknown
long snake	unknown
mango	857
oscillator (p15)	1445481003304129144171771
pond	36
pulsar (p3)	0
ship	516
snake	unknown
still life	180010010081
toad (p2)	8696
traffic light (p2)	1
tub	3906

In case you switch to a program that can read **RLE** files, here's a pattern containing the numbers listed above:

```
#C Smallest numbers which produce some small named objects
x = 19, y = 1225, rule = B3/S23
3ob3o$2bobobo$3ob3o$5bo$3ob3o$57$3ob3o$2bobobo$2bobobo$2bobobo$2bob3o
57$3ob3ob3ob3o$2bobobobobobo$3ob3obobob3o$2bo3bobobobobo$3ob3ob3ob3o
57$3obobo$2bobobo$3ob3o$5bo$3o3bo57$ob3ob3o$obo5bo$ob3ob3o$obobo3bo$o
b3ob3o57$3obob3o$3bobo$3obob3o$2bobobobo$3obob3o57$3obobob3o$2bobobo
3bo$3ob3ob3o$5bo$3o3bob3o57$3ob3ob3ob3o$obobo3bobobo$3ob3ob3ob3o$o
bobobo3bobobo$3ob3ob3ob3o57$3ob3ob3obo$2bobo5bobo$3ob3o3bobo$2bobobo3b
obo$3ob3o3bobo57$ob3ob3obob3ob3o$obobobo3bo3bobo$ob3ob3obo3bobo3o$obobo
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b3ob3o$3obobo3bo$3ob3o3bo$2bobobo3bo$3ob3o3bo57$3ob3o$2bobo$3ob3o$2bob
obo$3ob3o57$3ob3ob3o$obobo5bo$3ob3o3bo$obo3bo3bo$3ob3o3bo57$obob3o$obo
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3ob3obobo3bo$2bobo3bobo3bo$3ob3ob3o3bo57$3obobobob3obobo$obobobobo3bob
obo$3ob3obo3bob3o$2bo3bobo3bo3bo$3o3bobo3bo3bo!
```

Dean Hickerson

Le tableau des « small objects » évoqués par **Dean** sera mis à jour régulièrement, au fil des améliorations trouvées. La maison se permet de recommander l'injection du nombre 154299 dans le *Jeu de la Vie*, produisant une expansion infinie de toute beauté (illustrée ci-dessous) :

[Dean] :

I've found a number that produces infinite growth: 154299. I believe it's the smallest such number. In gen 539 it produces a *Corderman switch* engine (along with a lot of other junk) which travels southeast, leaving behind 4 blocks every 48 gens.

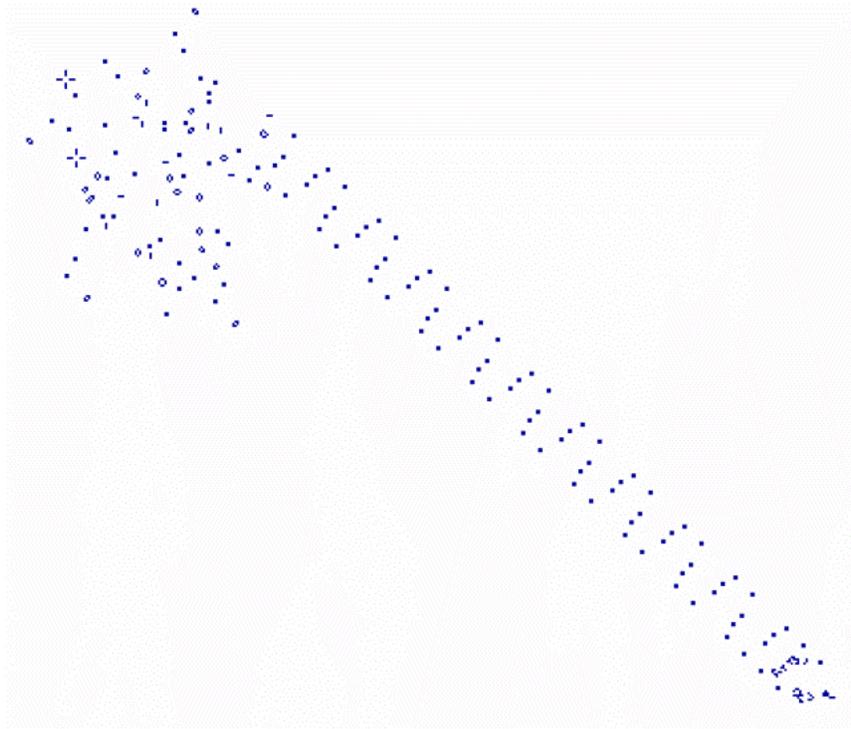
Quelle merveille, bravo Dean !

Voici un dictionnaire (en langue anglaise) qui permet de comprendre en quoi consistent « small objects » et autres configurations :

<http://www.bitstorm.org/gameoflife/lexicon/>

L'applet que nous utilisons le plus est toujours là :

<http://www.math.com/students/wonders/life/life.html>



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