Rerum Naturalium Fragmenta
No. 480

Tamas Jasko

Even size forms are more
common in Conway's life

.

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Simple analysis of frequency statistics reveals the fact that forms with an even number of live cells are more common in soups than odd ones. This should be naturally so for still life as the most common still life form is the 4-cell block, alone amounts for 31% of all forms. On the other hand the most common oscillating (periodic) form is the 3-cell blinker, similarly weighs in at 31 %. Therefore one expects that oscillating forms would be predominantly odd. This is not so, as seen in Table 1.

Table 1

Strict life forms (stats by Achenkamp & Groucher)

Code	Designation	Odd	Even	Total	Note
	Still life forms				
A	Block		32.0%	n/a	*1
B	Connected	31.7%	68.3%	100.0%	*2
C	Unconnected	1.5%	98.5%	100.0%	*2
	Oscillating (periodic) life forms				
L	Blinker	31.0%		n/a	*1
M	Connected	0.0%	100.0%	100.0%	*2
N	Unconnected	0.0%	100.0%	100.0%	*2
	Non-Stationary objects				
S	Moving or growing	>99.99%	<0.01%	100.0%	*2

Notes

*1   Per cent of all life in soups

*2   Per cent by category in random soups

The above analysis can be extended to other categories of forms that are not listed in the frequency counts of Achenkamp and Groucher, such as strict, pseudo and quasi life forms both still and oscillating. Classification of (still) life to Strict, Pseudo and Quasi forms and Constellations is given by [1]. Categories of connectedness are explained in more detail in a separate paper [3].

Table 2

Non-strict still life forms (own statistics by Countodd.exe)

Code	Designation	Odd	Even	Total	Notes
	Still life forms				
D	Pseudo	8.3%	91.7%	100.0%	*2
E	Quasi	38.2%	61.8%	100.0%	*2
F	Constellations	11.4%	88.6%	100.0%	*3
	Oscillating (periodic) life forms				
P	Pseudo	28.6%	71.4%	100.0%	*2
Q	Quasi	26.1%	73.9%	100.0%	*2
R	Constellations	59.1%	40.9%	100.0%	*3

Notes

*1   Per cent of all life in soups

*2   Per cent by category in random soups of 1.3 million life forms by Countodd.exe

*3   Per cent by category in non-random runs, of polyominoes ranging from xs_3 (blinker) to xs8_69ic (mango) that generated 206,000 life forms.

A) Block

This is the only still life that is rook-wise (Neumann) connected. It is the most common life form, 32 % of life in all soups are blocks.
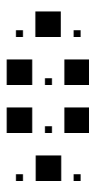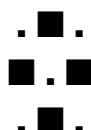
■■
■■

Block (xs4_33)

B) Connected strict still life

These forms are connected king-wise (Moore connected). The seven most common life forms in this category are Beehive (53.6%), Loaf (16.1%), Boat (14.6%), Tub (3.3%), Pond (3.3%), Ship (7.1%), and Longboat (1.0%), which altogether represent 98.9% of all forms.

Four of the commonest forms have an even number of cells: Beehive (53.6%), Tub (3.3%), Pond (3.3%), Ship (7.1%).

```
. ■ .        . ■ .        . ■ ■ .      ■ ■ .
■ . ■        ■ . ■        ■ . . ■      ■ . ■
■ . ■        . ■ .        ■ . . ■      . ■ ■
. ■ .                     . ■ ■ .
```

Beehive (xs6_696)   Tub (xs4_252)   Pond (xs8_6996) Ship (xs6_356)
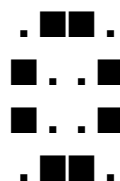
Three of the commonest forms have an odd number of cells: Loaf (16.1%), Boat (14.6%), Longboat (1.0%).

```
. ■ . .        . ■ .        . ■ . .
■ . ■ .        ■ . ■        ■ . ■ .
■ . . ■        ■ ■ .        . ■ . ■
. ■ ■ .                     . . ■ ■
```

Loaf (xs7_2596)   Boat (xs5_253)   Longboat (xs7_25ac)
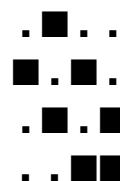
Including lesser forms listed by Achenkamp & Groucher, altogether there are twice as many even forms (68.3%) than odd ones (31.7%).

C) Unconnected strict still life

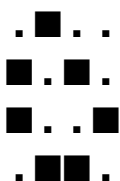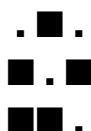The six most common life forms in this category are Carrier (77.7%), Bitable (4.7%), Cismirrorbun (2.7%), Blocktable (2.1%), Beehivedock (2.0%), Blockdock (1.9%). These altogether represent 91.0% of all forms. Each one of these have an even number of cells.

```
■■.          ■..■          .■■.
■..          ■■■■          ■..■
..■          ....          ■■■.
.■■          ■■■■          ....
             ■..■          ■■■.
                           ■..■
                           .■■.
```

Carrier (xs6_39c)   Bitable (xs12_raar)   Cismirrorbun (xs14_6970796)
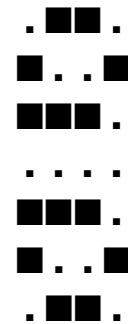
```
■..■         ■■..■■          ■■..■■
■■■■         ■....■          ■....■
....         .■■■■.          .■■■■.
..■■         ......          ......
..■■         .■■...          .■■...
             ■..■..          .■■...
             .■■...
```
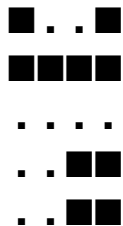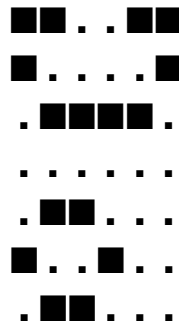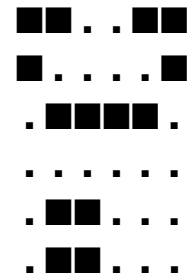
Blocktable   Beehivedock   Blockdock
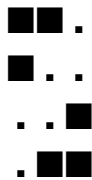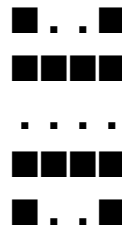(xs10_32qr)   (xs16_j1u0696z11)   (xs14_j1u066z11)

Including lesser forms listed by Achenkamp & Groucher, altogether there are over fifty times as many even forms (98.5%) than odd ones (1.5%).

Structural diagrams

In the structural diagrams illustrating common life forms, ■ stands for live cells. The name of the life form is followed by the APG code in (), and for non-strict forms the 'chemical style' formula, where B=boat, H=beehive, L=loaf, Lb=biloaf, i=blinker, o=block.

D) Pseudo still life

The six most common life forms in this category are Biblock (70.6%), Bunbun (7.1%), Bunbun-B (3.6%) (together 10.7%), Nest (5.2%), Region (4.8%), Biarritz (1.2%). These altogether represent 92.5% of all forms. Five of the six have an even number of cells, Region (4.8%) alone has odd.

```
■■          .■■.          .■.          .■■.          .■■
■■          ■..■          ■.■          .■■.          ■.■
. .         .■■.          ■.■          ....          .■.
■■          ....          .■.          .■■.          ...
■■          .■■.          ...          ■..■          .■.
            ■..■          .■.          .■■.          ■.■
            .■■.          ■.■                        .■■
                          ■.■
                          .■.
```

Biblock	Bunbun	Bunbun-B	Nest	Biarritz
(xs8_rr)	(xs12_6960696)	(xs12_696z696)	(xs10_660696)	(xs10_2l3z123)
[o2]	[H2]	[H2]	[Ho]	[B2]

```
    .■.              .■■.
    ■.■              ■..■
    ■■.              ■.■.
    ...              .■..
    ■■.              ....
    ■■.              .■..
                     ■.■.
                     ■.■.
                     .■..
```

Region (xs9_253033) [Bo]   Barley (xs13_6952z696) [HL]

Including lesser forms my statistics indicate that altogether there are ten times as many even forms (91.7%) than odd ones (8.3%). My statistics are based on random soups of over 1.3 million life forms which contained over 9,000 pseudo still life forms.

E) Quasi still life

The ten most common life forms in this category are Rapport (13.59%), Salt (13.11%), Salt-B (9.77%), Raisin (6.54%), Gate (3.91%), Leeft (3.73%), Gate-M (2.72%), Bakery (1.88%), Repair (1.84%), and Repair-B (1.71%), which altogether represent 58.80% of all forms.

Five of the commonest forms have an even number of cells: Rapport (13.59%), Salt (13.11%), Salt-B (9.77%), Leeft (3.73%), Bakery (1.88%), totalling 42.08%.

```
■■...    .■...      ....■■
■■...    ■.■..      ....■■
.....    ■.■..      ......
...■■    .■...      .■■...
...■■    .....      ■..■..
         ...■■      .■■...
         ...■■
```

Rapport	Salt	Salt-B
(xs8_330oo)	(xs10_25520oo)	(xs10_gg0696z11)
[o2]	[Ho]	[Ho]

```
.■.....        ....■■....
■.■....        ...■..■...
■.■....        ...■.■....
.■.....        .■■.■...■.
......         ■.■...■.■
...■■.         ■.■...■.■
..■..■         .■...■.■■.
...■■.         ...■.■...
               ...■..■...
               ....■■....
```
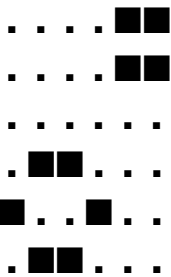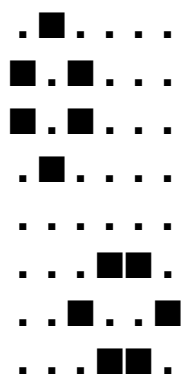
Leeft   Bakery
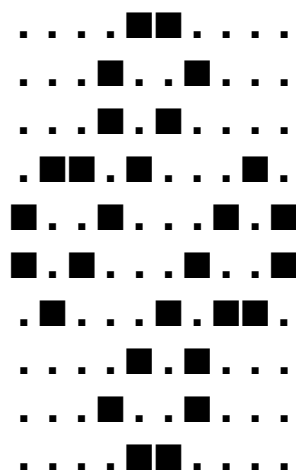
(xs12_696zw2552)   (xs28_g88m952g8gz1218kid221)

[H2]   [Lb2]

Five of the commonest forms have an odd number of cells: Raisin (6.54%), Gate (3.91%), Gate-M (2.72%), Repair (1.84%), Repair-B (1.71%), totalling 16.72%.

```
.■■.          ■■...         ...■..
■..■          ■■...         ..■.■.
.■.■          .....         ..■..■
..■.          ...■.         ...■■.
....          ..■.■         ......
.■..          .■..■         ■■....
■.■.          ..■■.         ■■....
■.■.
.■..
```

Raisin   Gate   Gate-M
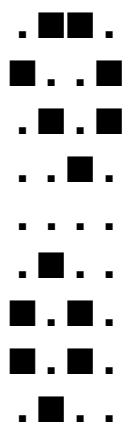
(xs13_2596z696)   (xs11_3308kic)   (xs11_w69a4z33)
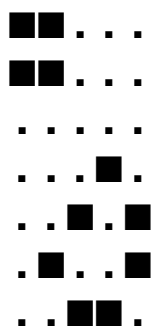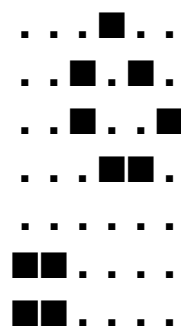
[HL]   [Lo]   [Lo]

```
■■...    .■...
■■...    ■.■..
.....    ■■...
...■.    .....
..■.■    ...■■
..■■.    ...■■
```

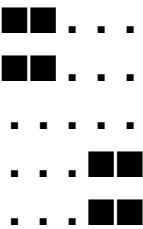Repair
(xs9_3308kc)
[Bo]

Repair-B
(xs9_2530oo)
[Bo]

Including lesser forms my statistics indicate that altogether there are about twice as many even forms (61.8%) than odd ones (38.2%). My statistics are based on random soups of over 1.3 million life forms which contained over 24,000 quasi still life forms.
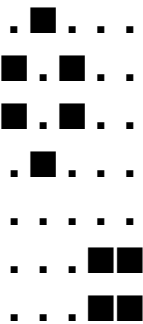
F) Constellations of still life

The eight most common life forms in this category are Honeyfarm (29.7%), Blockade (13.2%), Cheptomino (9.2%), Hives (3.9%), Guiles (3.7%), Debris (2.7%), Tonnage (2.4%), Savage (1.8%), which altogether represent 66.6% of all forms. Seven of the eight have an even number of cells, Tonnage (2.4%) alone has odd.

```
. . . . . . . ■ . . . . . .
. . . . . ■ . ■ . . . . . .
. . . . . ■ . ■ . . . . . .
. . . . . . ■ . . . . . . .
. . . . . . . . . . . . . .
. ■ ■ . . . . . . . ■ ■ .
■ . . ■ . . . . . ■ . . ■
. ■ ■ . . . . . . ■ ■ .
. . . . . . . . . . . . . .
. . . . . . ■ . . . . . . .
. . . . . ■ . ■ . . . . . .
. . . . . ■ . ■ . . . . . .
. . . . . . ■ . . . . . . .
```
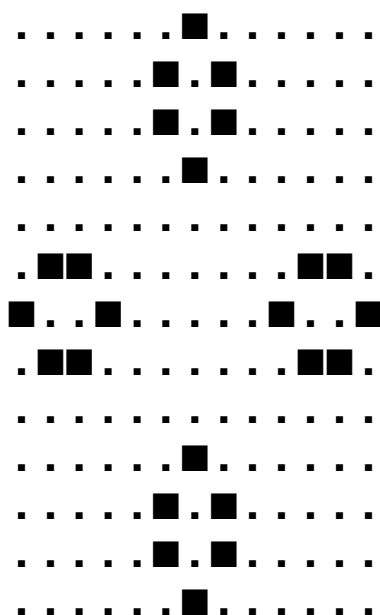
Honeyfarm (xs24_y1696z2552wgw2552zy1343) [H4]

```
■ ■ . . . . . . . . . . . . . . . . . . . .
■ ■ . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . .
. ■ ■ . . . . . . . . . . . . . . . . ■ ■ .
. ■ ■ . . . . . . . . . . . . . . . . ■ ■ .
. . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . ■ ■
. . . . . . . . . . . . . . . . . . . . ■ ■
```
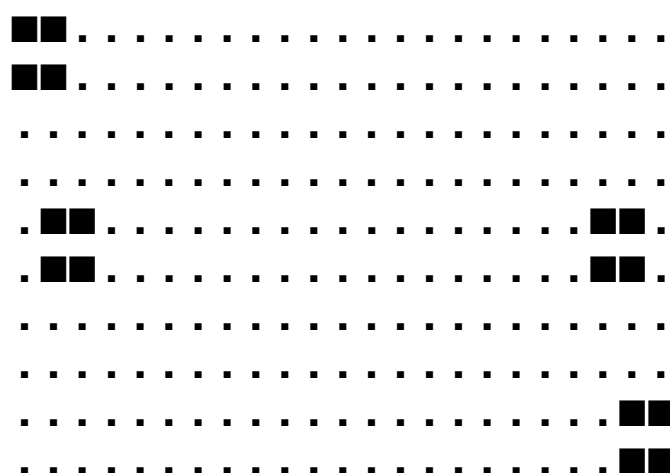
Blockade (xs16_33w66zzzzy033w66) [o4]

```
■■..........................................
■■..........................................
..........................................■■.
.........................................■.■
..........................................■■
............................................
............................................
............................................
.........■■.................................
.........■■.................................
............................................
............................................
.....................■■.....................
.....................■■.....................
```
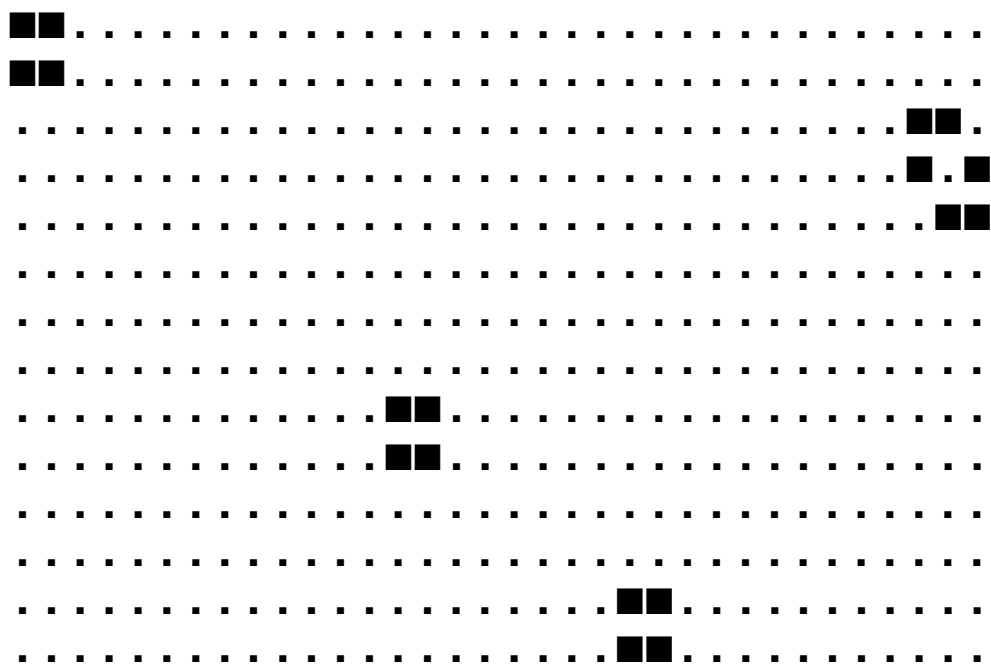
Cheptomino (xs18_33zzy4oozzy866zzw6ac) [So3]

```
.■■.......
■..■......
.■■.......
..........
..........
.......■.
......■.■
......■.■
.......■.
```
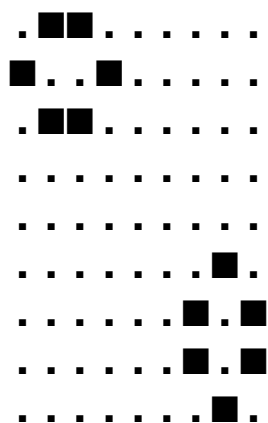
Hives (xs12_2552zy2696) [H2]

```
■■........
■■........
..........
■■........
■■........
..........
.......■■
.......■■
```
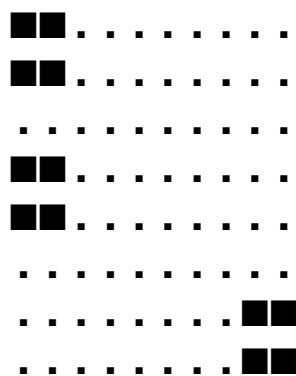
Guiles (xs12_rrzy466) [o3]

Debris (xs14_653zycx66zy733) [So2]

Tonnage
(xs29_y9352zzy166y58kk8zzzy066zggz11zy6ggzy5321) [BHSo3]

```
.■■.......
■..■......
■.■.......
.■.....■..
......■.■.
......■..■
.......■■.
```
Savage (xs14_6952zx4aic) [L2]

Including lesser forms there are altogether about eight times as many even forms (88.6%) than odd ones (11.4%). My statistics are based on soups resulting from of over 210,000 polyominoes which contained over 34,000 constellations of still life forms.

L) Blinker

This is the only oscillating (periodic) life form that is always rook-wise (Neumann) connected. It is the second most common of all life forms, 31 % of life in all soups are blinkers.

```
■■■
```
Blinker (xp2_7)

Another life form, the Toad is rook-wise connected in one of its stages (see below).

M) Connected strict oscillating life

These oscillating (periodic) forms are connected king-wise (Moore connected). The four most common life forms in this category are Toad (76.23%), Beacon (23.71%), Clock (0.02%), and Pentadecathlon (0.02%), which altogether represent 98.99% of all forms. All of these have an even number of cells.

Note that oscillating forms have different configurations in the course of the period, so e.g. a period 4 form may have 4 different shapes with a different number of cells and different degree of connectedness. The figures below show the standard (minimal) apg code and the most connected stage, which may or may not be the same as the stage coded. As an example, the code (xp2_318c) codes the 6-cell stage of Beacon, while the image shows the 8-cell, connected stage.

Toad (xp2_7e)   Beacon (xp2_318c)   Clock (xp2_2a54)

Pentadecathlon (xp15_4r4z4r4)   Tub-test-tubebaby (xp2_03544oz4a511)
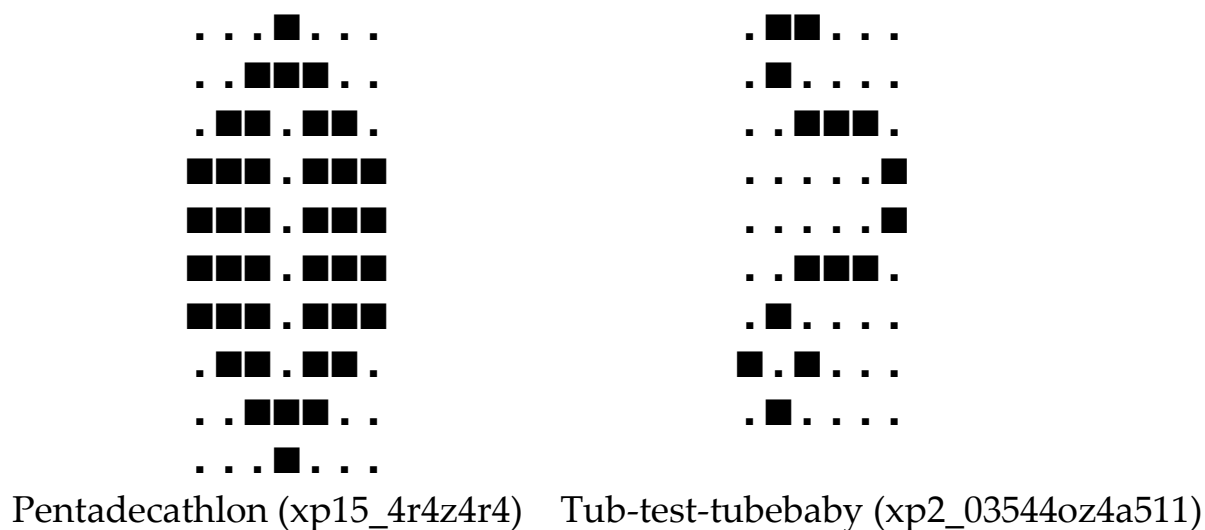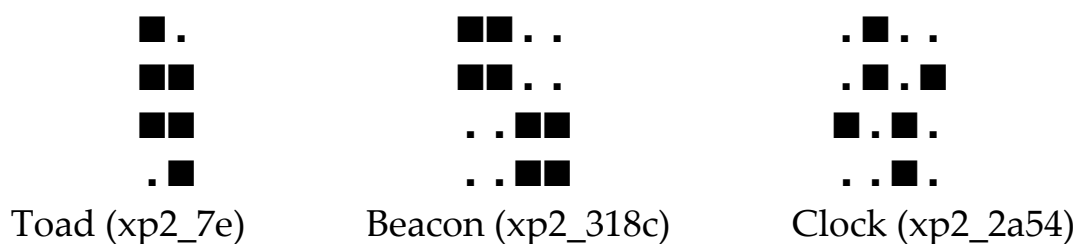
Including lesser forms listed by Achenkamp & Groucher, practically all forms are even (over 99.999%), the most frequent odd one, Tub-test-tubebaby is 29th in Achenkamp's list, 3 million times less frequent than toad.

N) Unconnected strict oscillating (periodic) life

The four most common life forms in this category are CP-pulsar (99.99%), trans-beacon_and_table (0.001%), cis-beacon_and_table (0.001%), cis-beacon_and_dock (0.001%), cloverleaf (0.001%). These together represent over 99.99% of all forms. Each one of these have an even number of cells.

```
..■■.....■■..
...■■...■■...
■..■.■.■.■..■
■■■.■■.■■.■■■
.■.■.■.■.■.■.
..■■■...■■■..
.............
..■■■...■■■..
.■.■.■.■.■.■.
■■■.■■.■■.■■■
■..■.■.■.■..■
...■■...■■...
..■■.....■■..
```
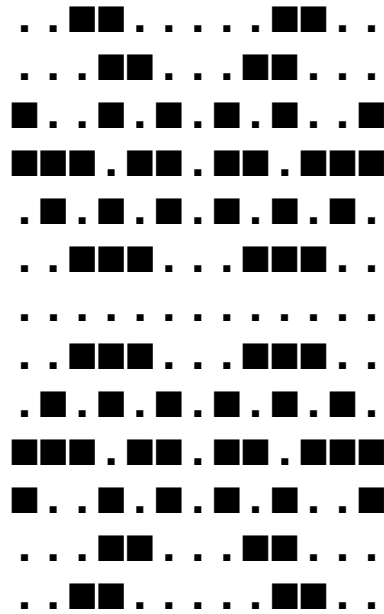
CP-pulsar (xp3_s0111s0s1110szo0555o0o5550oz1044410144401)

```
..■..■
..■■■■
......
..■■..
..■■..
■■....
■■....
```

```
■■..
■■..
..■■
..■■
....
■■■■
■..■
```

```
■■..■■
■....■
.■■■■.
......
.■■...
.■■...
...■■.
...■■.
```
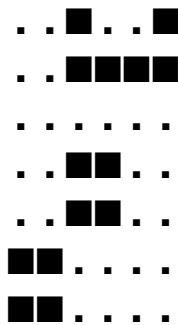
Trans-beacon_and_table (xp2_wbq23z32)

Cis-beacon_and_table (xp2_318c0f9)
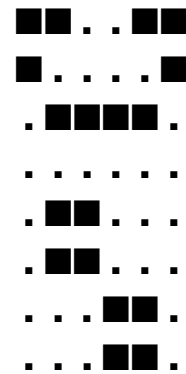
Cis-beacon_and_dock (xp2_j1u062goz11)

```
. .■■. . . .■■. . .
.■. . .■.■. . .■.
.■. .■■. .■■. .■.
■■. . .■.■. . .■■
. .■.■■■.■■■.■. .
■■. . .■.■. . .■■
.■. .■■. .■■. .■.
.■. . .■.■. . .■.
. .■■. . . .■■. .
```
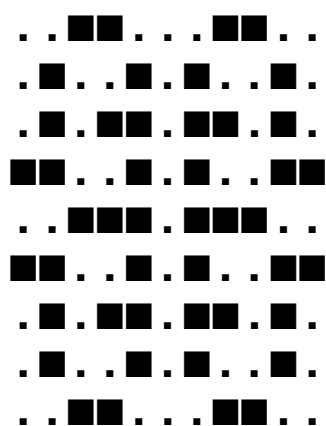
Cloverleaf (xp4_8eh5m0m5he8z178a606a871)

Including lesser forms listed by Achenkamp & Groucher, practically all forms are even (99.999%), there are very few odd ones (0.001% or less).

P) Periodic pseudo life forms (Neumann neighbours)

The six most common life forms in this category are Pelican (46.26%), Record (26.07%), Quacks (10.15%), Professor (8.33%), Log (5.98%), and Target (1.82%), which altogether represent 98.61% of all forms.

Four of the commonest forms have an even number of cells: Pelican (46.26%), Quacks (10.15%), Professor (8.33%), and Log (5.98%), totalling 70.72%.

```
■            ■■.        ■■. .        .■■.
■            ■.■        ■■. .        ■. .■
■            .■.        . . . .       ■.■.
.            . . .       ■■. .        .■. .
■            . . .       ■. . .        . . . .
■            ■■■        . . .■        . . . .
■                       . .■■        ■■■.
```

Pelican	Quacks	Professor	Log
(xp2_nz3)	(xp2_352w7)	(xp2_rbzw23)	(xp2_6952w7)
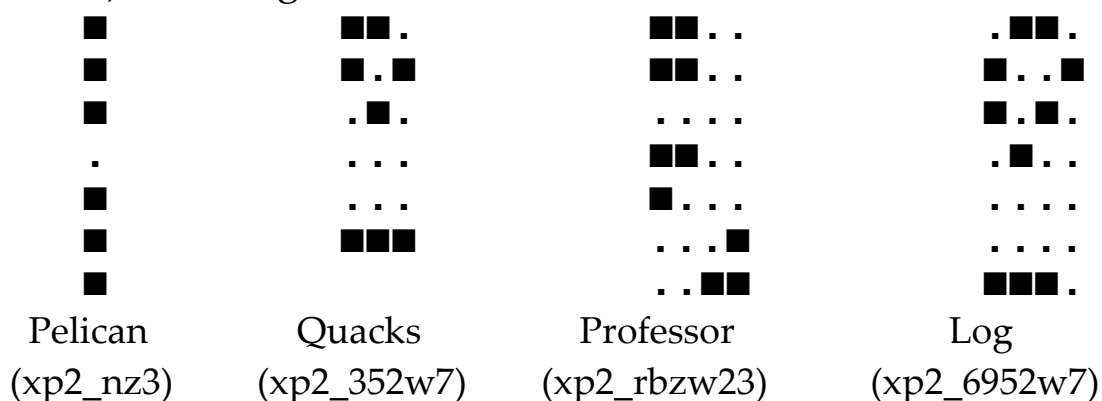
Two of the commonest forms have an odd number of cells: Record (26.07%), and Target (1.82%), totalling 27.89%.

```
     ■■■              .■.
     . . .            ■.■
     . . .            .■.
     .■.              . . .
     ■.■              . . .
     ■.■              ■■■
     .■.
  Record (xp2_2552w7)    Target (xp2_252w7)
```

Including lesser forms my statistics indicate that altogether there are more than twice as many even oscillating (periodic) pseudo life forms (71.8%) than odd ones (28.2%).

Q) Quasi periodic (oscillating) life

The five most common life forms in this category are Traffic (49.33%), Page (17.78%), Triffic (15.85%), Toil (2.61%), and Moan (2.17%), which altogether represent 87.74% of all forms.

Two of the commonest forms have an even number of cells: Traffic (49.33%), Page (17.78%), totalling 67.11%.

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  . .■■■. .          ■■■. .
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  ■. . . . .■        . . . .■
  ■. . . . .■        . . . .■
  ■. . . . .■        . . . .■
  . . . . . . .
  . .■■■. .
  Traffic (xp2_s01110szw222)   Page (xp2_1110s)
        [i4]                       [i2]
```

Three of the commonest forms have an odd number of cells: Triffic (15.85%), Toil (2.61%), and Moan (2.17%), totalling 20.63%.
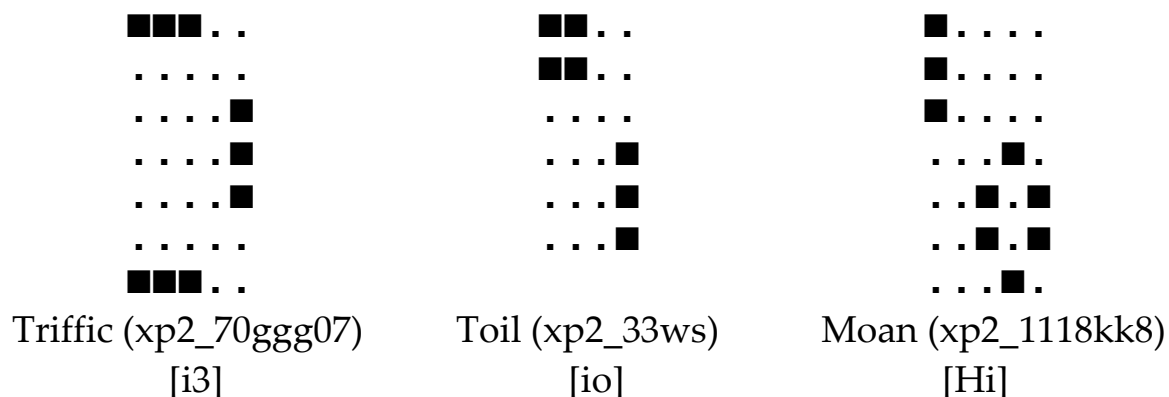
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■■■..        ■■..        ■....
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....■        ....        ■....
....■        ...■        ...■.
....■        ...■        ..■.■
.....        ...■        ..■.■
■■■..                    ...■.
```

Triffic (xp2_70ggg07)   Toil (xp2_33ws)   Moan (xp2_1118kk8)
          [i3]   [io]   [Hi]

Including lesser forms my statistics indicate that altogether there are more than twice as many even oscillating (periodic) pseudo life forms (73.8%) than odd ones (26.2%).

R) Constellations of oscillating (periodic) life

The eleven most common life forms in this category are Iezero (20.8%), Shadow (10.8%), Epelican (3.6%), Gilquist (2.8%), Idu (2.8%), Cough (2.7%), Interchan (1.7%), Fool (1.32%), Routing (1.20%), Jinxed (1.08%), and Visual (1.03%) which altogether represent 49.9% of all forms.

Six of the commonest forms have an even number of cells: Epelican (3.6%), Idu (2.8%), Cough (2.7%), Interchan (1.7%), Fool (1.32%), Jinxed (1.08%), and Visual (1.03%) totalling 14.3%.

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. . . . . . ■■ . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . ■ . ■ . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . ■ . . . . . . . . . . . . . . . . . . . . . . . .
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■■ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
■■ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . ■ .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . ■ . ■
. . . . . . . . . . . . . . . . . . . . . . . . . . . . ■ . ■
■ . . . . . ■ . . . . . . . . . . . . . . . . . . . . . . ■ .
■ . . . . . ■ . . . . . . . . . . . . . . . . . . . . . . . .
■ . . . . . ■ . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . ■■■ . . . . . . . . . . . . . . . . . . . . . . . . . . .
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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . ■■ . .
. . . . . . . . . . . . . . . . . . . . . . . . . . ■■ . .
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Idu (xp2_y1352zoozzoy1oycy1696z1044401zycy7cc) [BHi3o2]
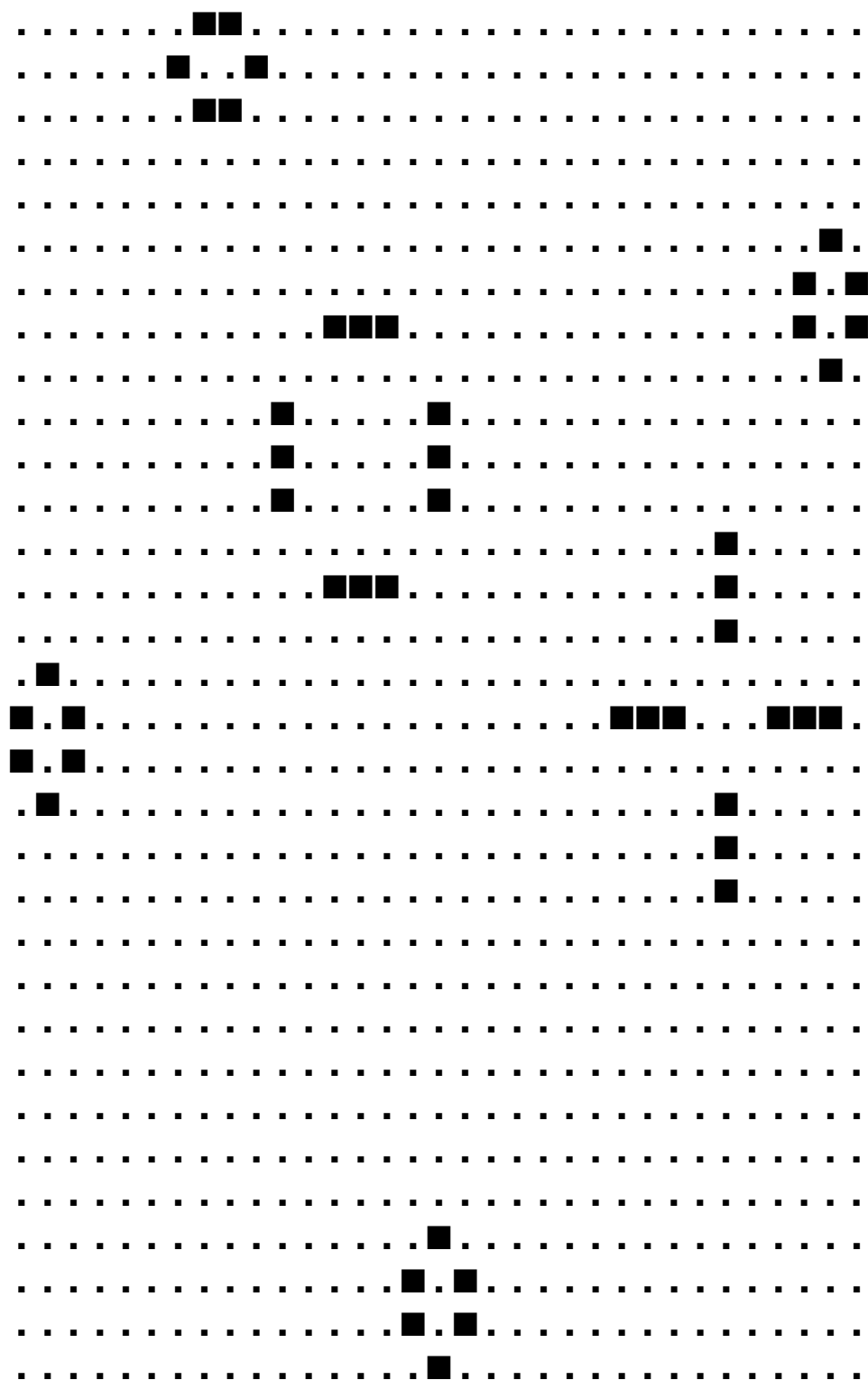
Cough
(xp2_yb2552zciczy3s01110szy5222yc2552zycozy84440h0444zy12552y33)
[H4i8]

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■■■. . . . . . . .
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. . . . . . . . .■
. . . . . . . . .■
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Epelican (xp2_111zy2s) [i2]

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■. . . . . . . . . . .■
■. . . . . . . . . . .■
■. . . . . . . . . . .■
. . . . . . . . . . . . . .
. .■■■. . . .■■■. .
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Interchan (xp2_ggg07y270gggzy0ey2e)   [i6]

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■. . . . . . . . . . . . .■■
■. . . . . . . . . . . . .■■
■. . . . . . . . . . . . . .
. . . . . . . . . . . . . . . .
. .■■■. . . . . . . . . . .
. . . . . . . . . . . . . . . .
■. . . . . . . . . . . . . .
■. . . . . . . . . . . . . .
■. . . . . . . . . . . . . .
. . . . . . . . . . . . . . . .
. . . . . . . . . . . . .■■■.
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Fool (xp2_70gggy633zezy9111) [i4o]

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........■■..........................
........■■..........................
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Visual (xp2_111zzzycy333zzybszyccczy966) [i2o3]

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.....■■......
.....■.■.....
■■...■■....
■■.........
..........■
..........■
....■■....■
....■■......
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Jinxed (xp2_w7zccx356zy066y0111) [Si2o2]

Four of the commonest forms have an odd number of cells: Iezero (20.8%), Shadow (10.8%), Gilquist (2.8%), and Routing (1.2%), totalling 32.6%.

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. . . . . . .██. . . . . . . . . . . . . . . . . . . . . . . . . .██. . . . . .
. . . . .█. .█. . . . . . .██. . . . . .██. . . . . .█. .█. . . . .
. . . . .█. .█. . . . . . .██. . . . . .██. . . . . .█. .█. . . . .
. . . . . .██. . . . . . . . . . . . . . . . . . . . . .██. . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . .███. . . . . . . . . . . . . . . . . . . . . . .███. .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
█. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .█
█. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .█
█. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .█
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . .██. . . . . . . . . . . . . .██. . . . .
. . . . . . .██. . . . . . . . . . . . . .██. . . . .
. . . . .██. . . . . . . . . . . . . . .██. . . . .
. . . . .██. . . . . . . . . . . . . . .██. . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . .███. . . . . . . . . . . . . . . .
```
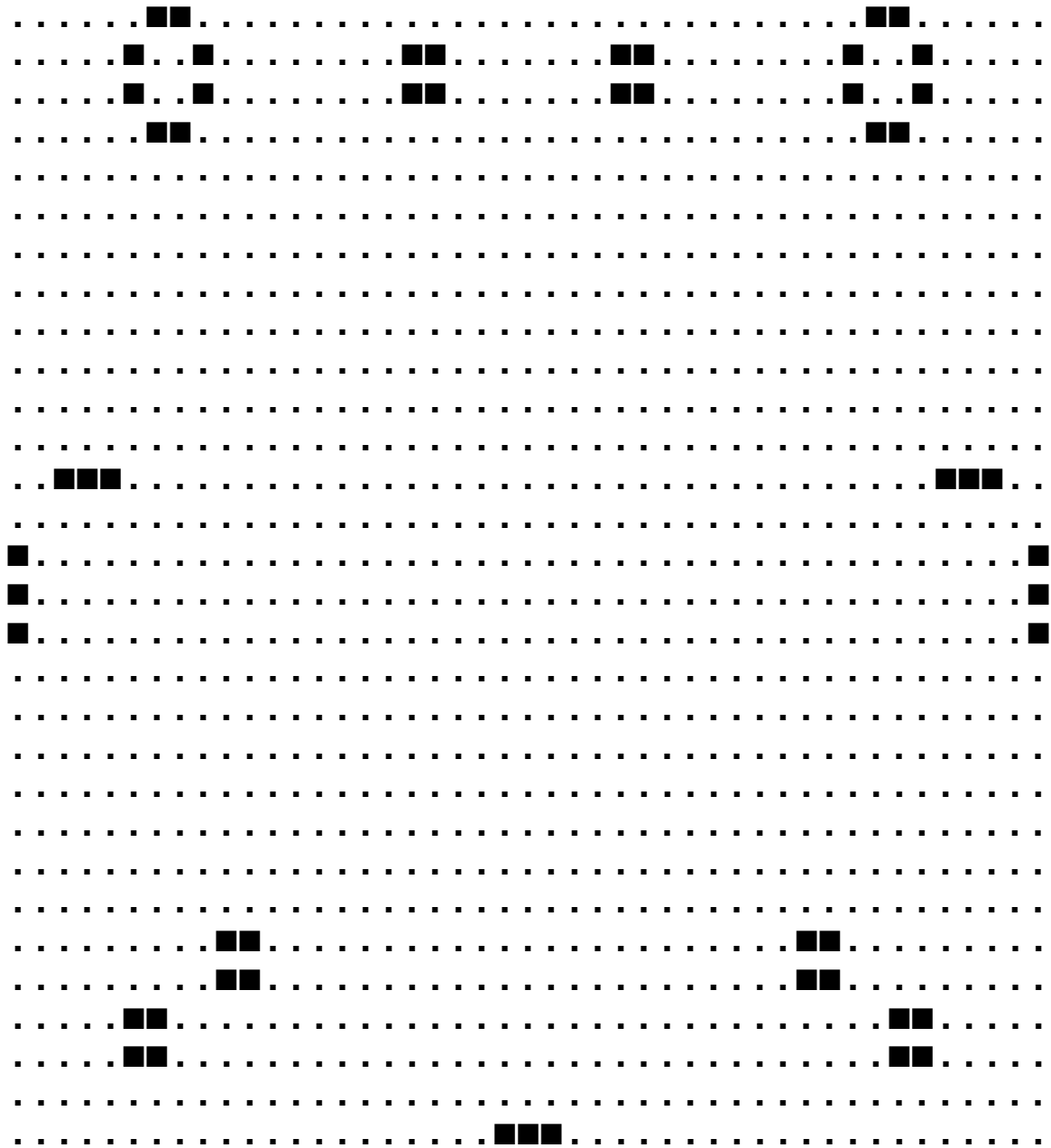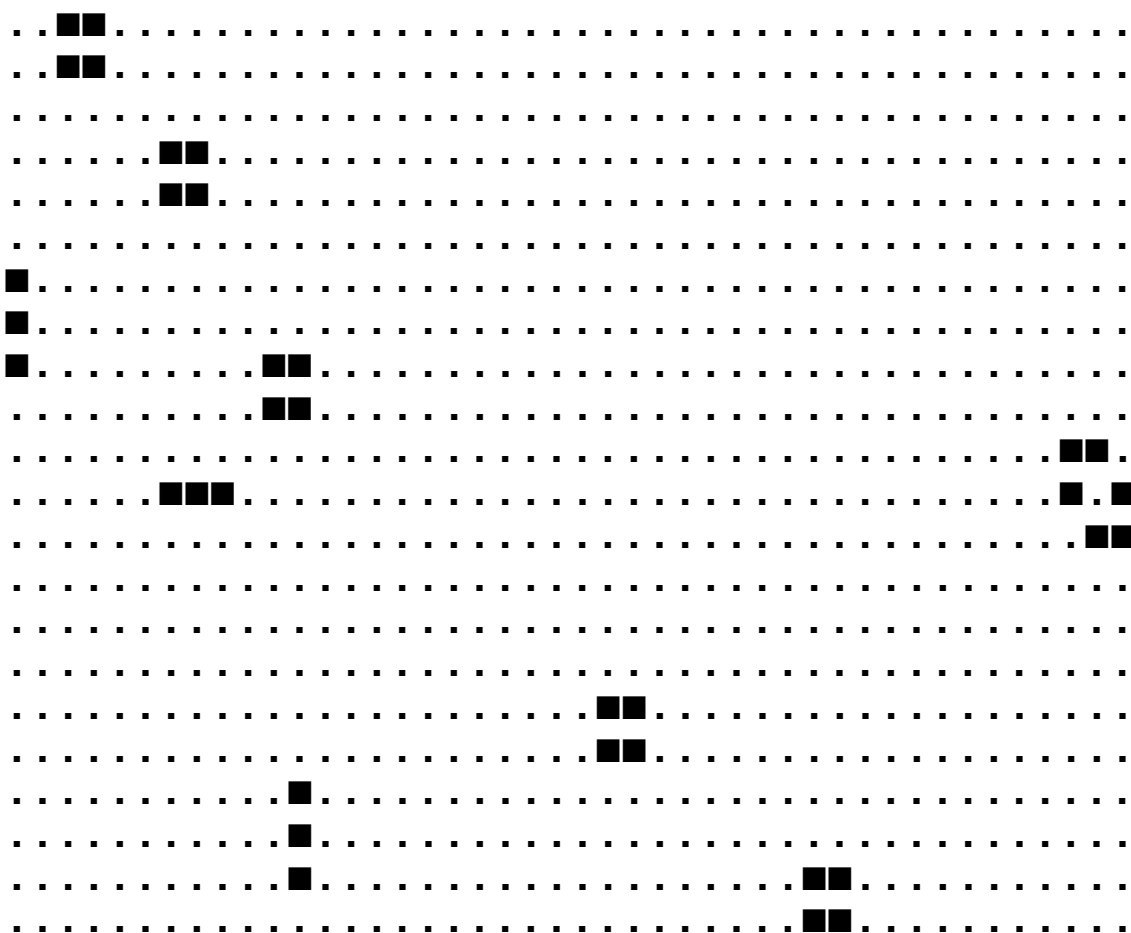
Iezero
(xp2_y8s0111z6996ycy0gg33zycy411z0cczycy
9ez066zycy4ggzciicycy011oozy870ggg)
[P2i5o6]

Shadow (xp2_33z66z66yas) [io3]

Gilquist [H4io5]

(xp2_ya33wccy0g8gz0gycy2121x4aa4y2ooz343ycy22552zyaooyc33zycxs)

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..██.............................................
..██.............................................
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........█...................██...................
............................██...................
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Routing
(xp2_w33woozey5oozy2222ycyc356zy7oy766zy71ycx33)
[Si3o5]

Including lesser forms my statistics indicate that altogether there are significantly more odd constellations of oscillating (periodic) life forms (59.3%) than even ones (40.3%).

S) Moving forms (gliders, spaceships)

The three most common life forms in this category are Glider (99.96%), Smallfish (lightweight spaceship, 0.03%), Mediumfish (medium spaceship, 0.01%) which altogether represent over 99.9% of all forms. All three are odd, and thus moving forms are practically all odd. There are however some

moving forms with an even number of cells, but these are extremely rare.

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■.■           ■.■.            ..■■■
■■.           ...■            .■..■
.■.           ...■            ....■
              ■..■            ■...■
              .■■■            ....■
                              .■.■.
```

Glider (xq4_153)   Smallfish (xq4_6frc)   Mediumfish (xq2_27dee6)

Conclusions

Even forms predominate in most categories, except blinkers, moving forms and oscillating constellations.

References

[1] https://www.conwaylife.com/wiki/Still_life
[2] https://www.conwaylife.com/ref/lexicon/lex_q.htm#quasistilllife
[3] Jasko, T.: Degrees of connectedness in Conway's life (in preparation)