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Title

Comparatistics for morphoCAs
Differentiations, Developments and Reductions

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Abstract

Two main modi of change are considered:
a) differentiations of a pattern of a given complexity,
b) developments of a pattern from one level to another level of complexity.
The reverse movement is implemented as the process of reduction.
The classical approach to cellular automata is covered by a black-and-white universe.
Is there a natural way to a colored and colorful universe out of the established black-and-white universe?
There is without doubt a natural way to reduce a colorful universe into a black-and-white one.
Considering the fact that classical cellular automata are morphogrammatically incomplete it seems to be difficult to develop automata concepts of a higher complexity.
Obviously, every black-and-white pattern might be colored arbitrarily by some voluntary or intuitive interests. But that has nothing to do with a conscious algorithmic approach to complexity/complication of developing patterns.
What is a well known strategy, also applied in similar situations, like many-valued logic, there is always a way to augment complexity in a secondary way. This strategy of complexity augmentation is called here augmentation of complication. Complexity and complication are complementary concepts in a polycontextural systems theory.
The stipulation of polycontextural and morphogrammatic writing is: Complexity first, simplicity last.

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Comparatistics for morphoCAs

Differentiations, Developments and Reductions

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Conceptual background

Two main modi of change are considered:
a) *differentiations* of a pattern of a given complexity,
b) *developments* of a pattern from one level to another level of complexity.

The reverse movement is implemented as the process of *reduction*.

The classical approach to cellular automata is covered by a black-and-white universe.

Is there a natural way to a colored and colorful universe out of the established black-and-white universe?

There is without doubt a natural way to reduce a colorful universe into a black-and-white one.

Considering the fact that classical cellular automata are morphogrammatically incomplete it seems to be difficult to develop automata concepts of a higher complexity.

Obviously, every black-and-white pattern might be colored arbitrarily by some voluntary or intuitive interests. But that has nothing to do with a conscious algorithmic approach to complexity/complication of developing patterns.

What is a well known strategy, also applied in similar situations, like many-valued logic, there is always a way to augment complexity in a secondary way. This strategy of complexity augmentation is called here *augmentation of complication*. Complexity and complication are complementary concepts in a polycontextural systems theory.

The stipulation of polycontextural and morphogrammatic writing is*: Complexity first, simplicity last.*

"Simplicity is what is left after complexity; not what precedes it." (Jeff DeGraff)

The exercise shows *differentiations* of some patterns in the framework of the morphoCAs DCKV-(5,5,5) and morphoCA-(5,4,5) and *developments* of patterns from *moprhoCA*$^{(3,3)}$ to *morphoCA*$^{(5,5)}$.

Topics are:
differentiations,
overlapping,
mixtures,
parallelism.

How to keep track of the experiments?

Registry keyboard

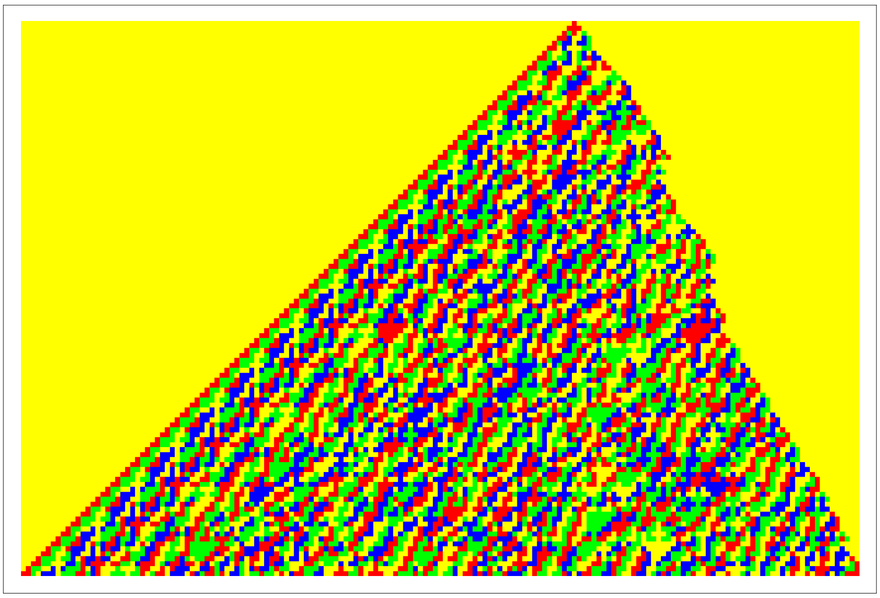
There is a 'registry' keyboard included. It helps to store the chosen key-constellations and by copying manually the graphics by Bitmap the session is stred for further analysis.

List of the registered constellation might be collected and used for an additional menu-oriented implementation the claviature of the of morphoCA.

Registry keyboard for ruleDCKV

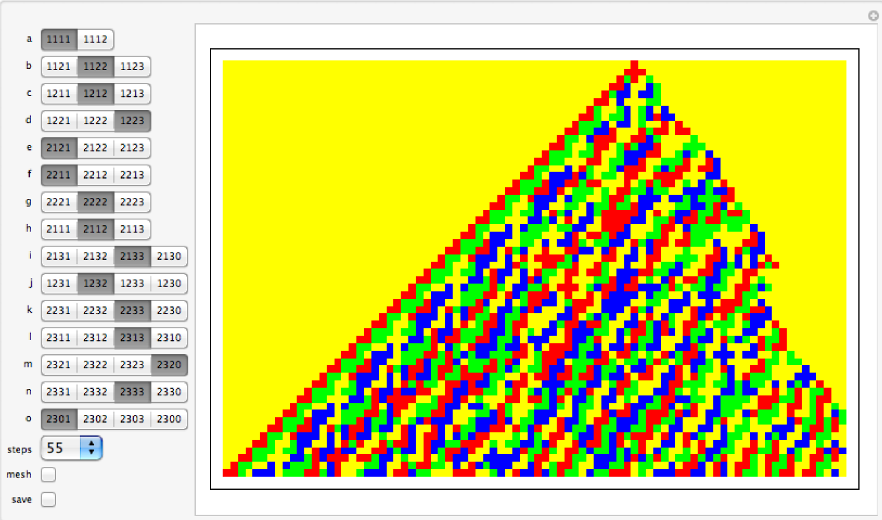
keyboard			
1111	1112		
1121	1122	1123	
1211	1212	1213	
1221	1222	1223	
2121	2122	2123	
2211	2212	2213	
2221	2222	2223	
2111	2112	2113	
2131	2132	2133	2130
1231	1232	1233	1230
2231	2232	2233	2230
2311	2312	2313	2310
2321	2322	2323	2320
2331	2332	2333	2330
2301	2302	2303	2300

111 111 221 212 122 321 212 211 222 221 122 113 123 222 332 301

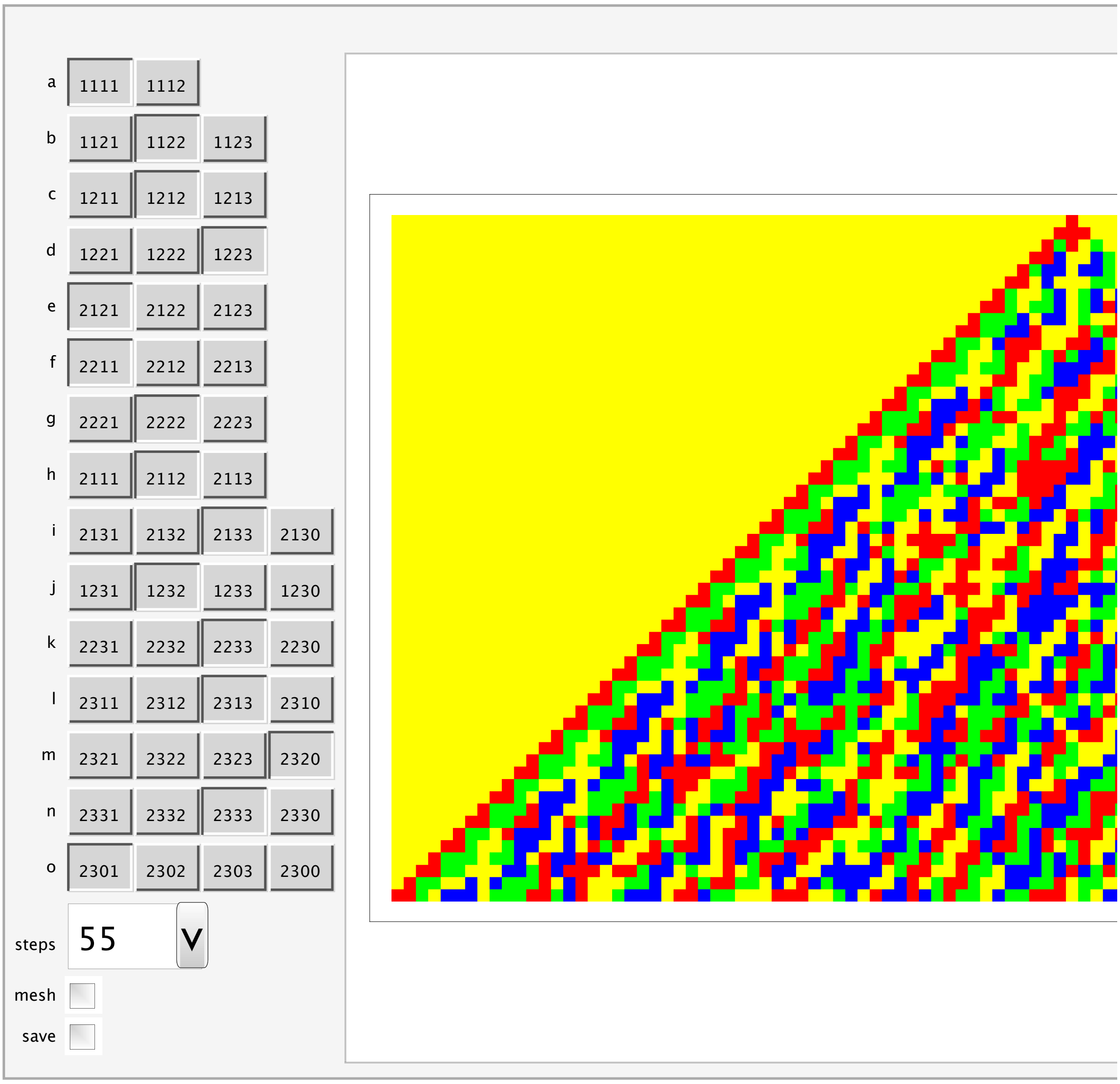


Bitmap

A more direct implementation to store the keys and the graphics is not yet elaborated. An easy approach is to store the **Bitmap** of the claviature constellation. It stores the visualization and its corresponding keys.

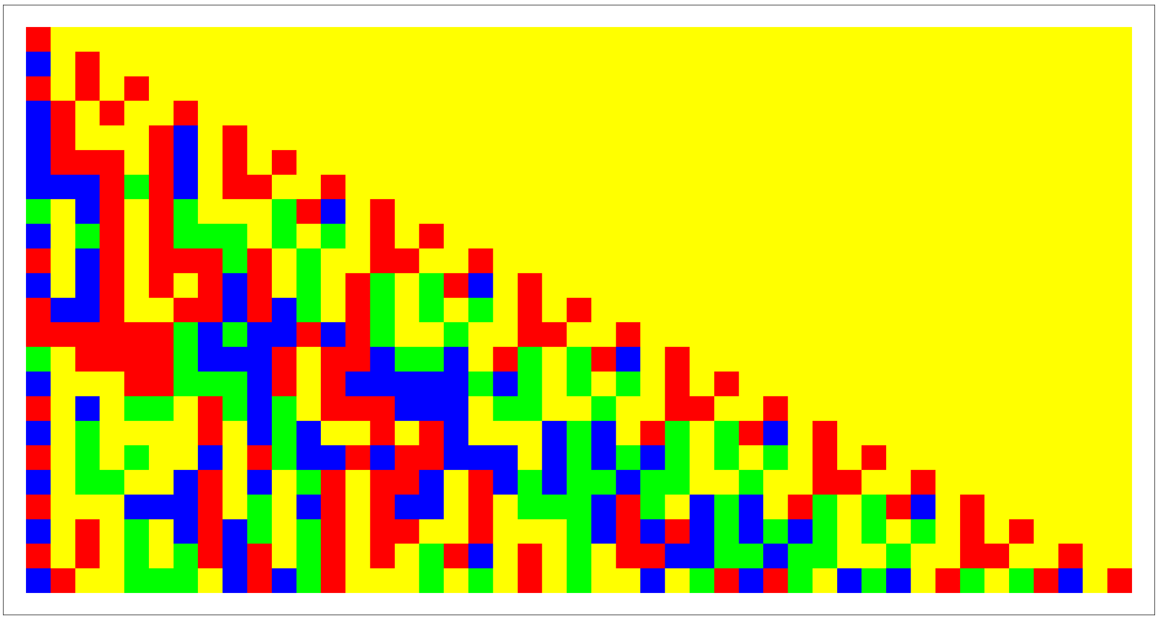

a 1111 1112
b 1121 1122 1123
c 1211 1212 1213
d 1221 1222 1223
e 2121 2122 2123
f 2211 2212 2213
g 2221 2222 2223
h 2111 2112 2113
i 2131 2132 2133 2130
j 1231 1232 1233 1230
k 2231 2232 2233 2230
l 2311 2312 2313 2310
m 2321 2322 2323 2320
n 2331 2332 2333 2330
o 2301 2302 2303 2300
steps 55
mesh
save

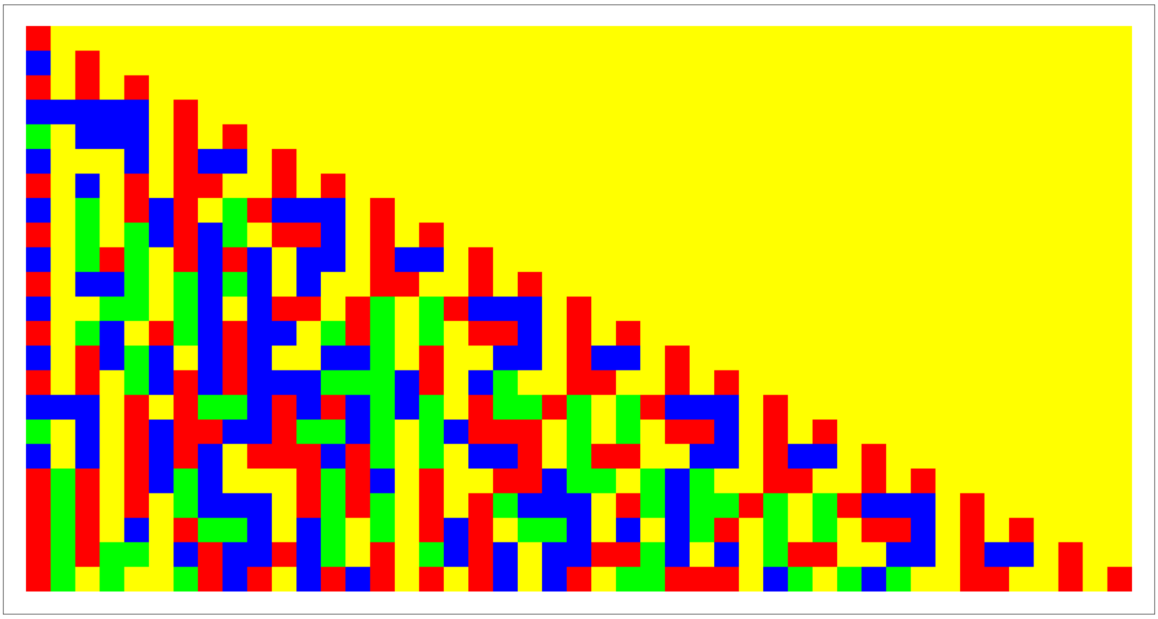
Examples for morphoCA$^{(5,5,5)}$

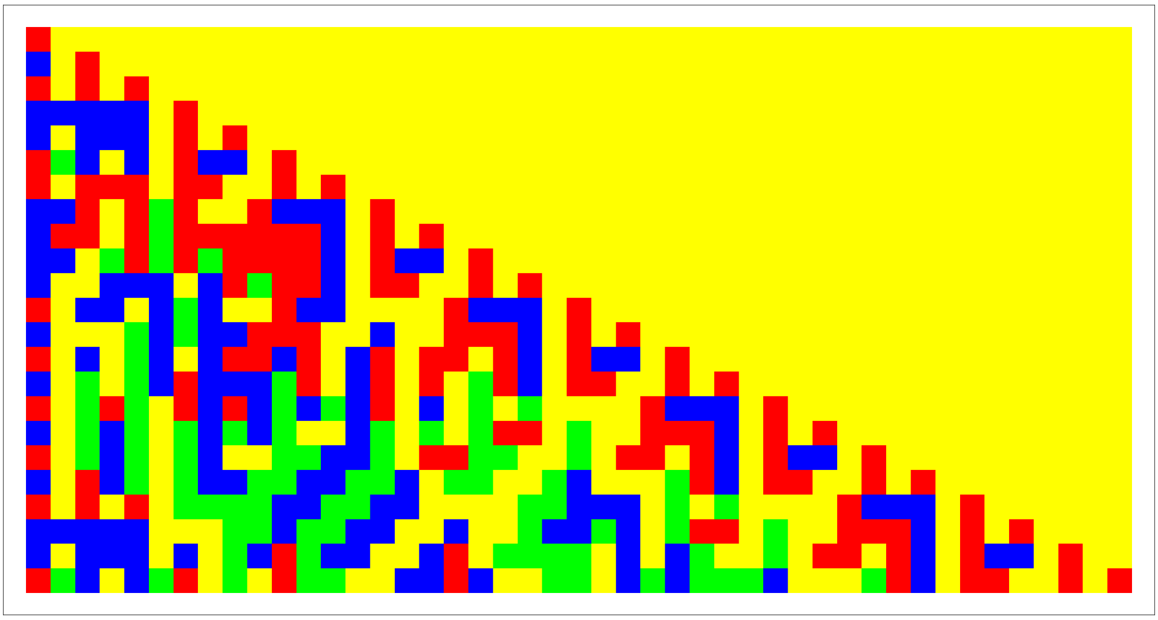


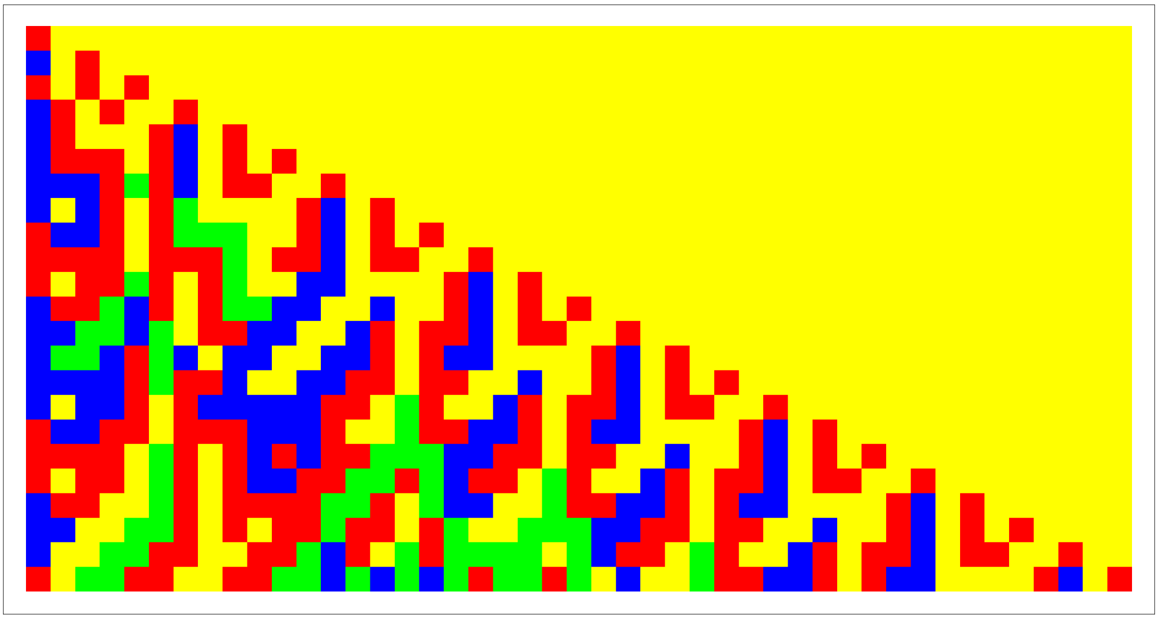
Differentiations between morphoCA$^{(3,3)}$ and morphoCA – DCKV$^{(5,5,5)}$

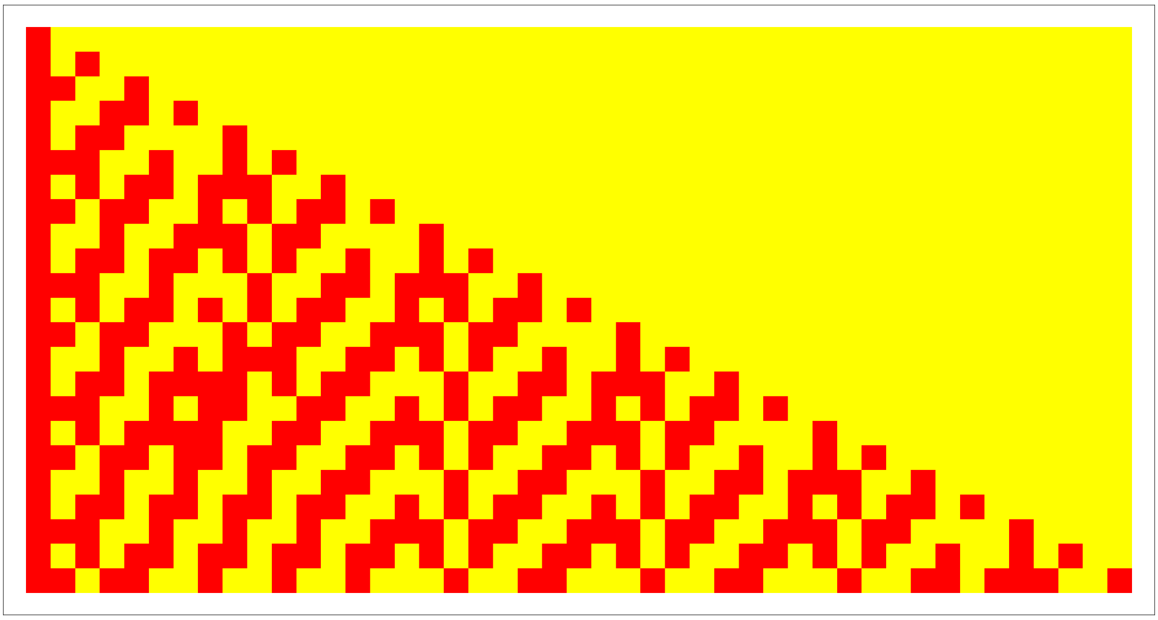
Differentiations

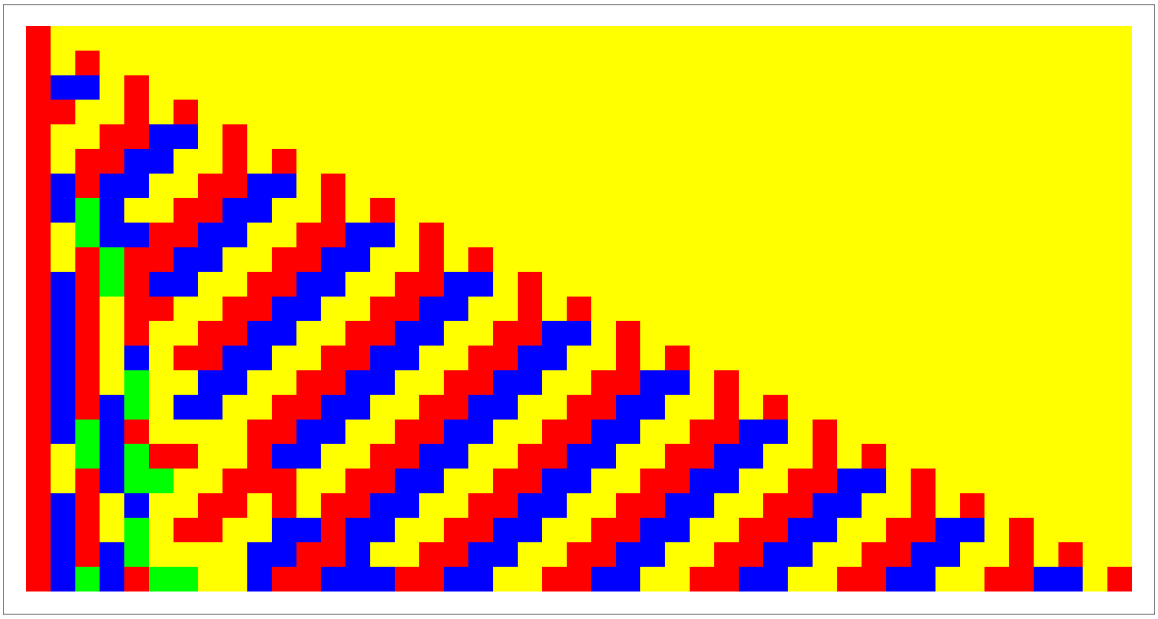




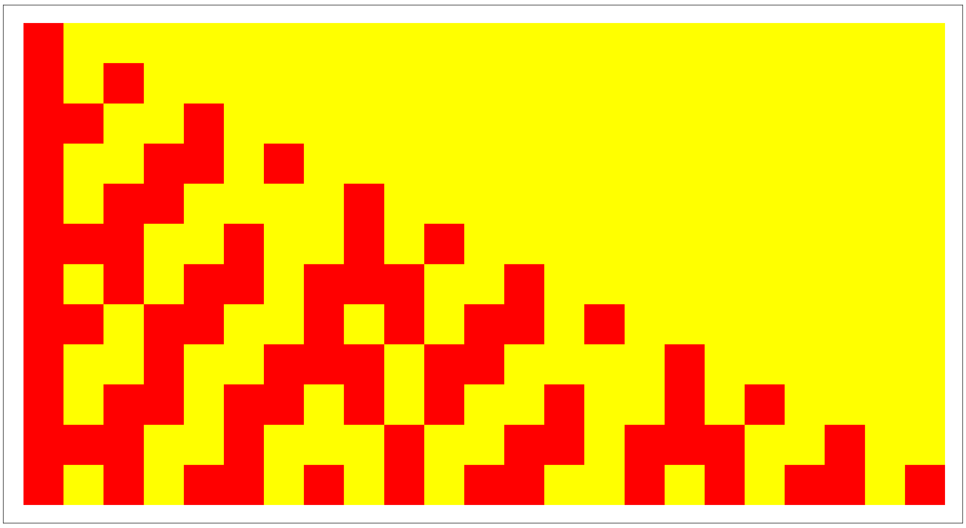


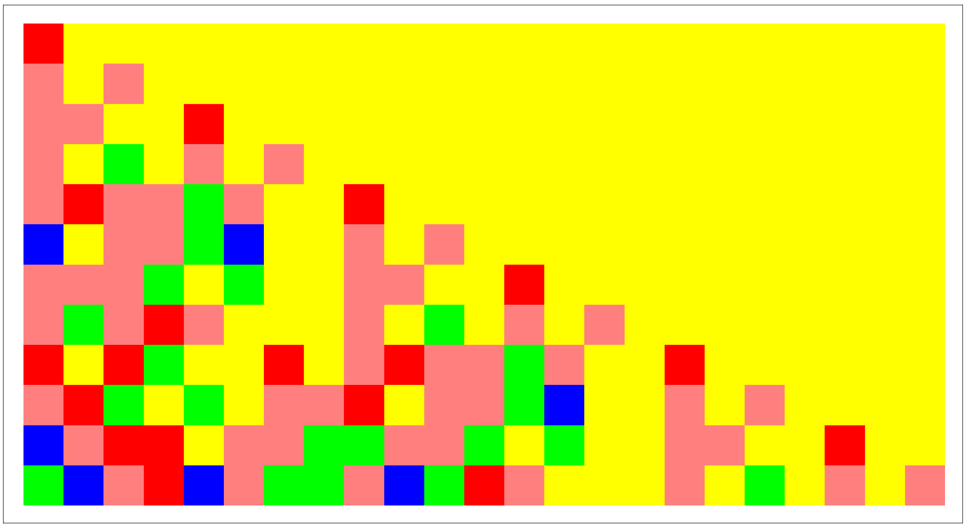


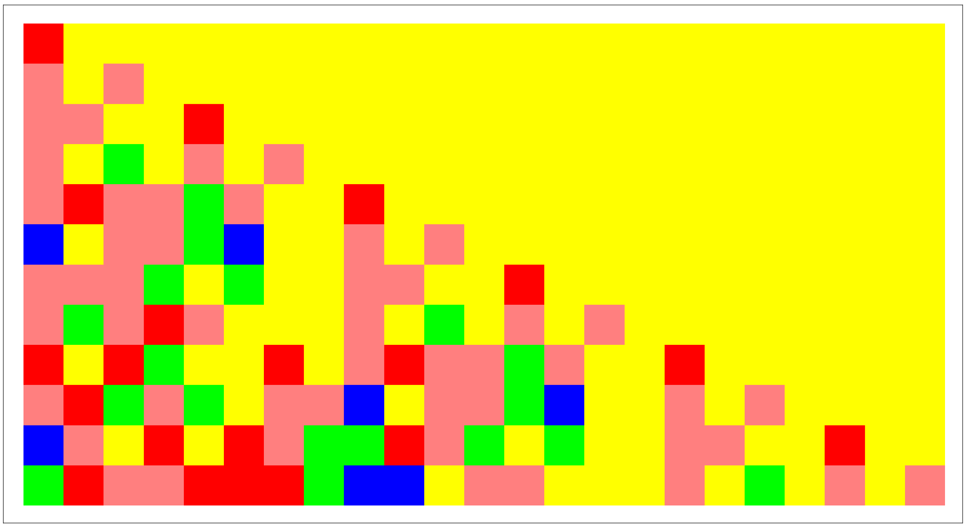


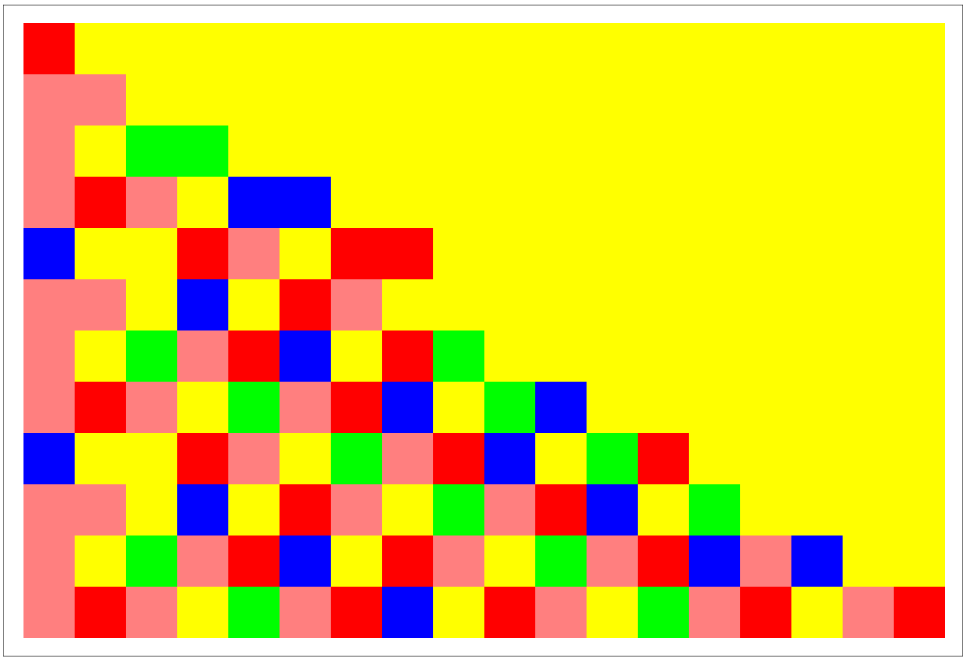


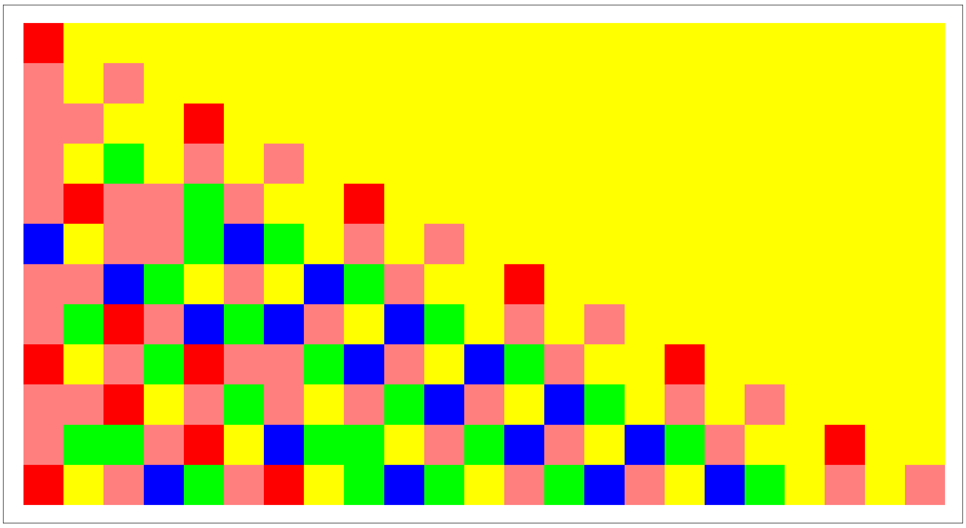
Differentiations



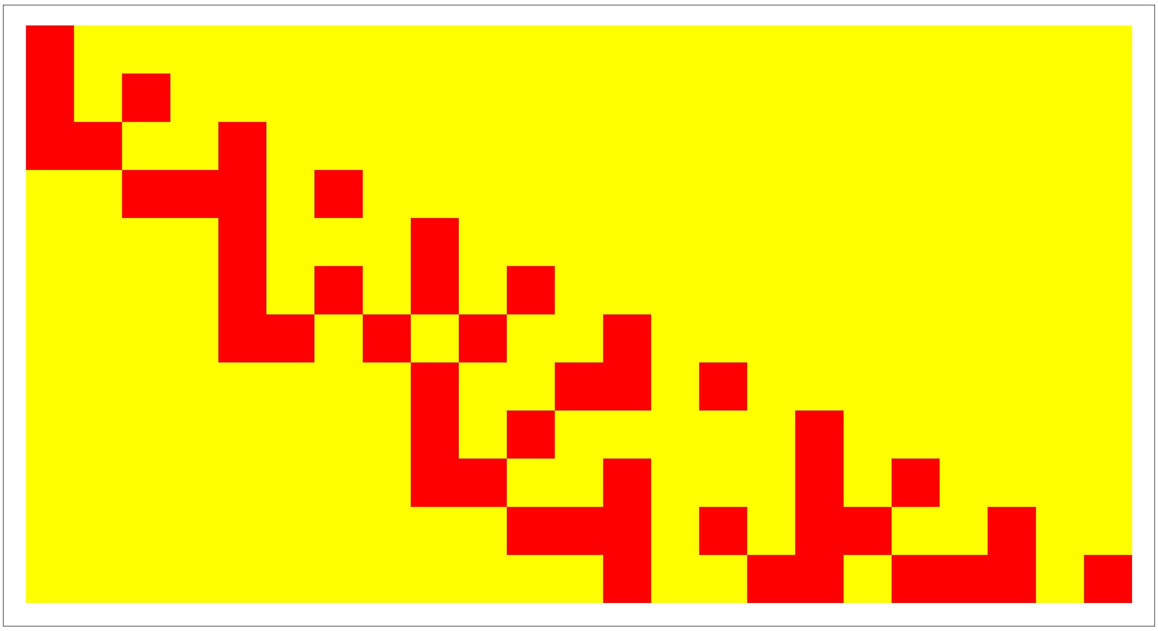


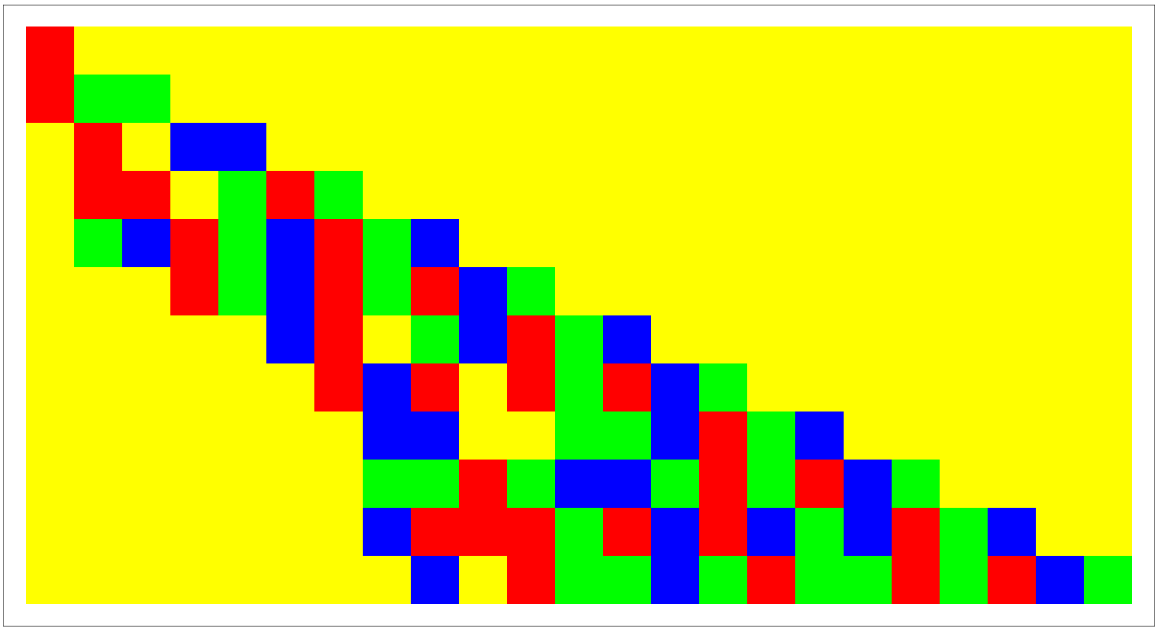


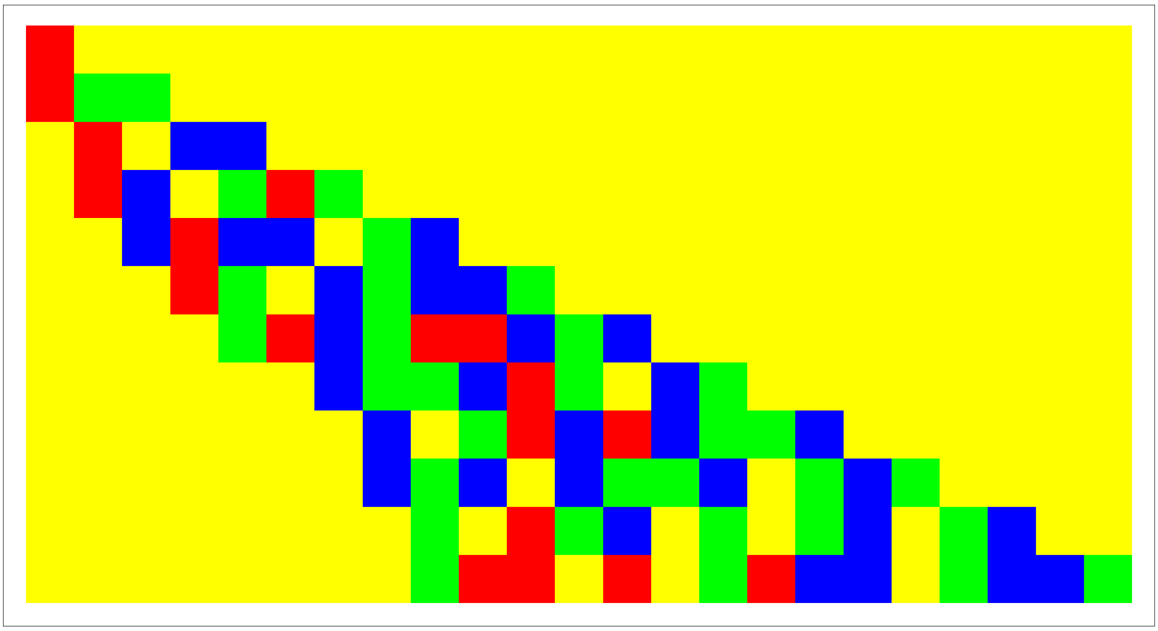


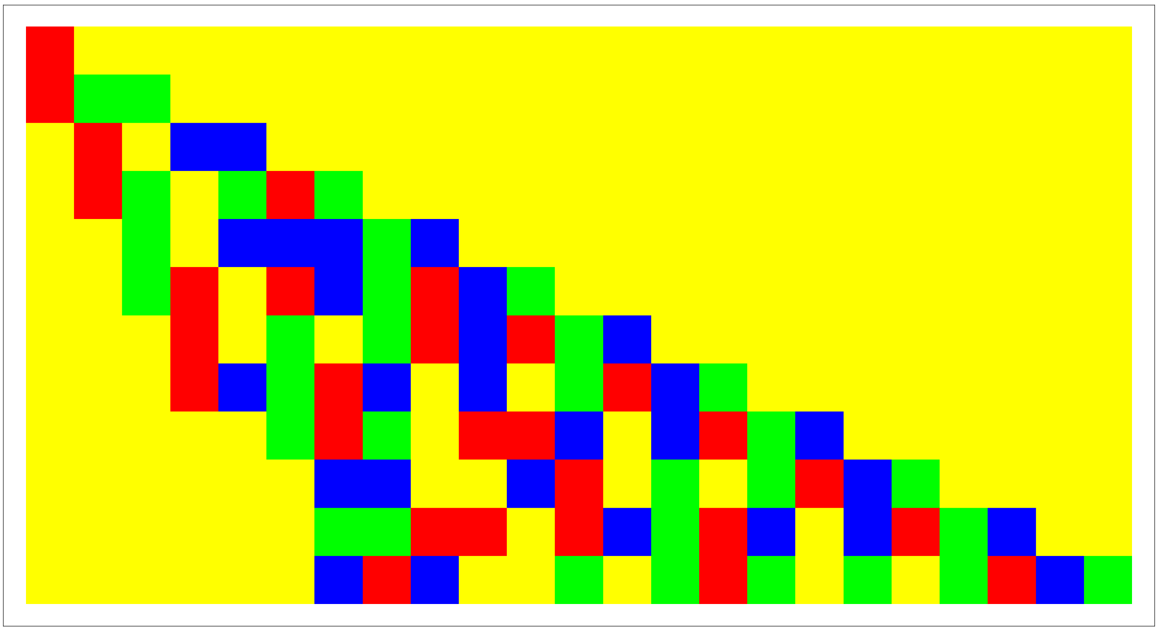


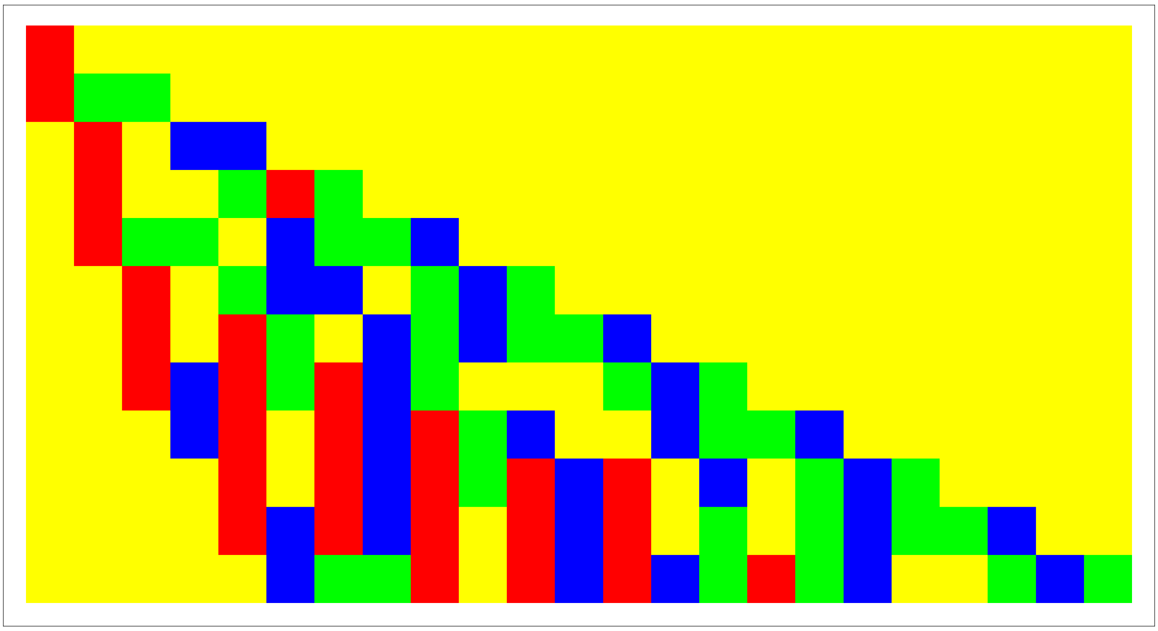
Differentiations

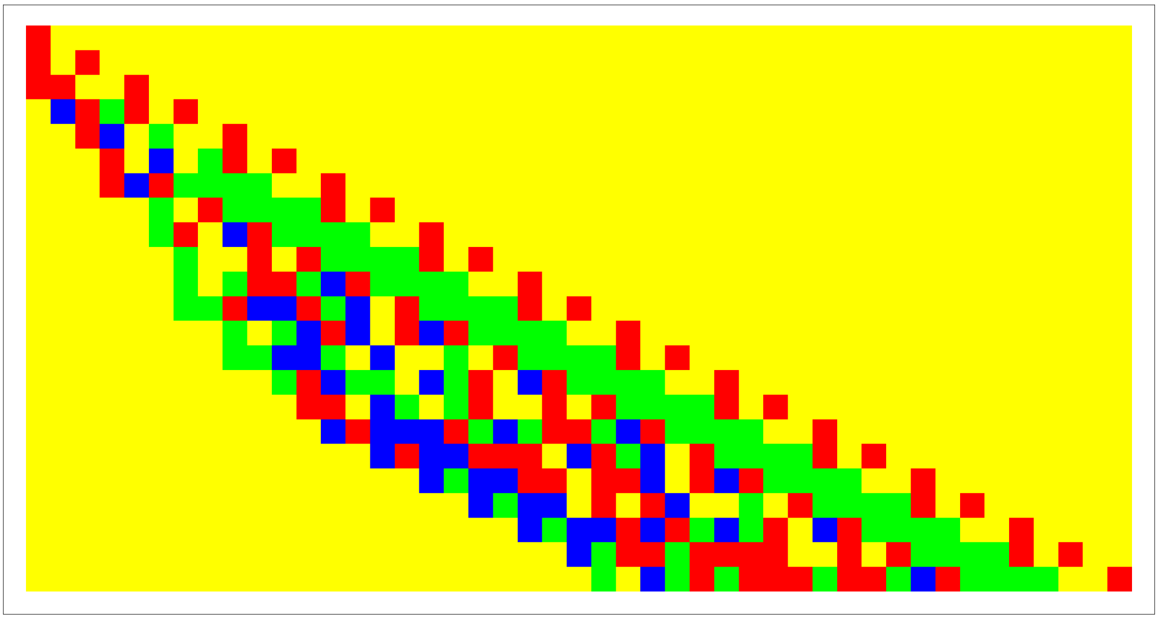


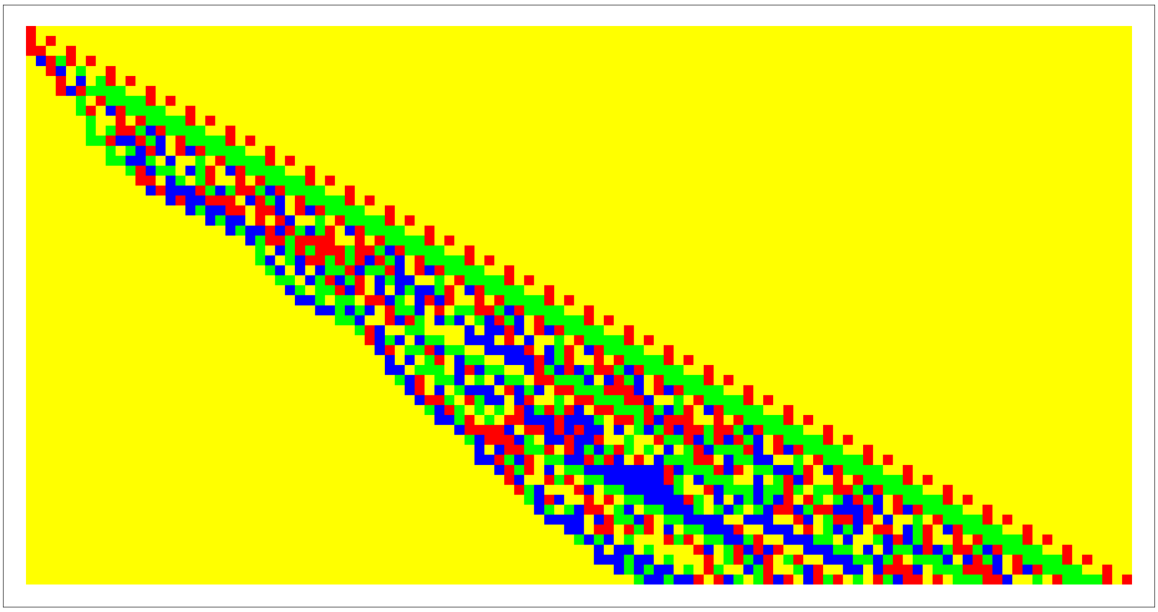


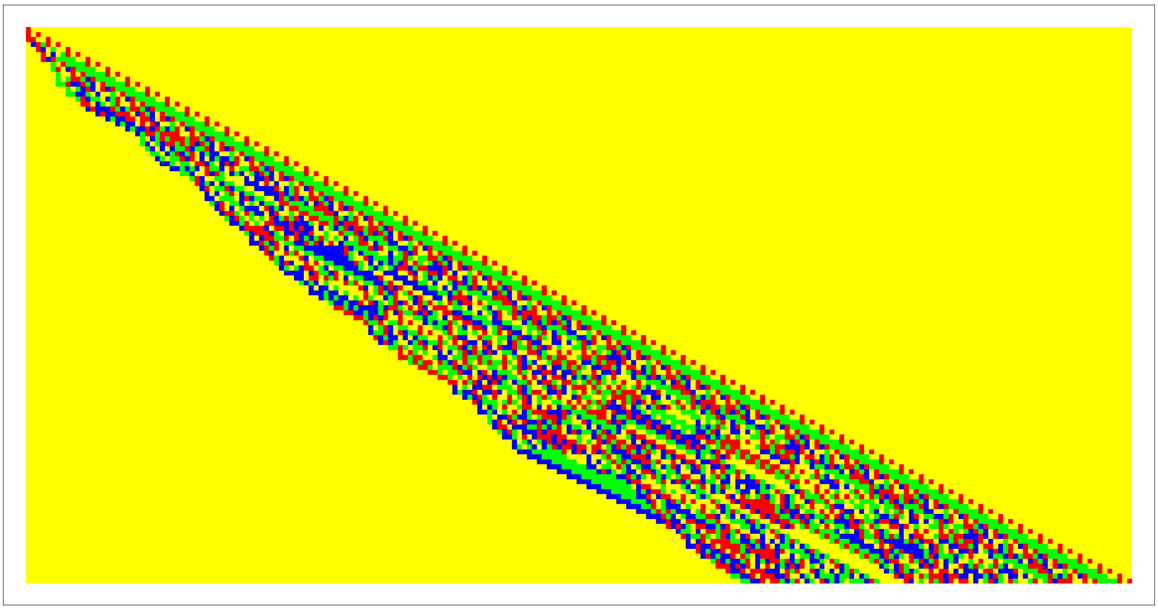


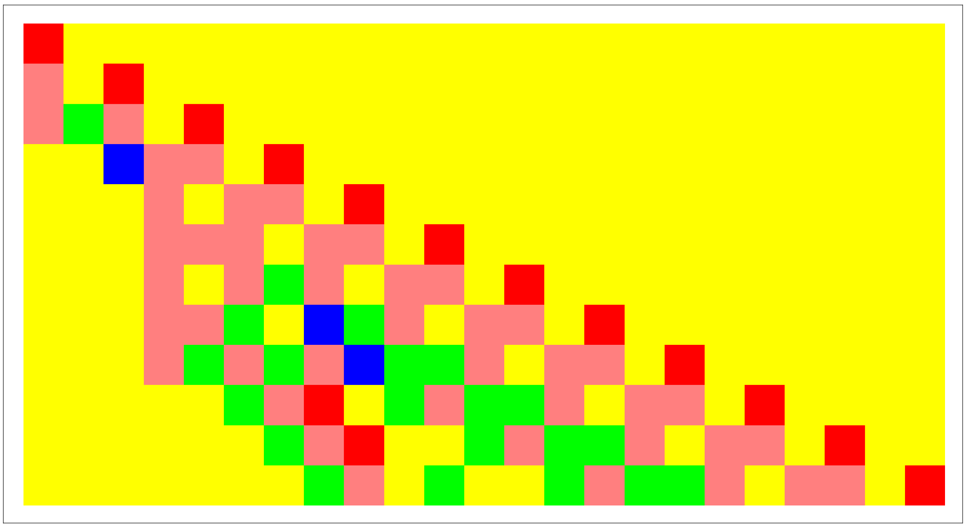


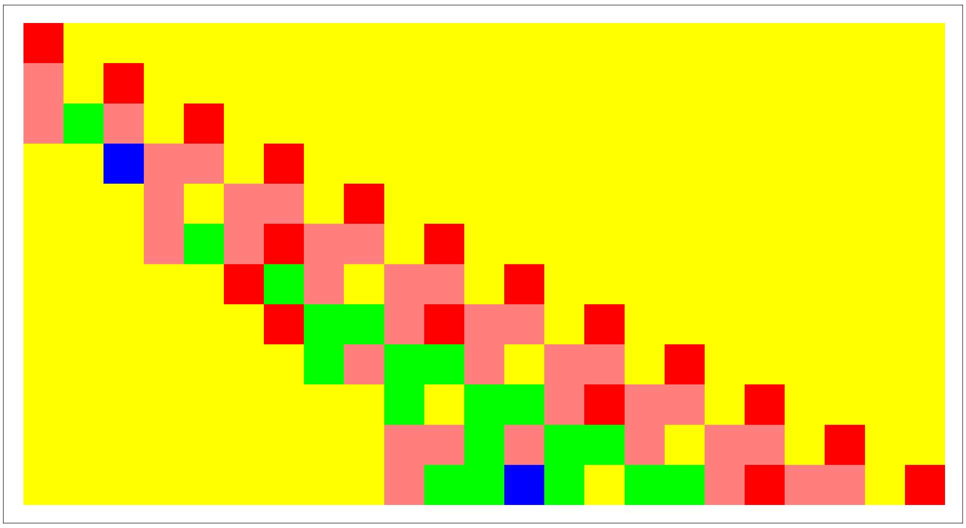


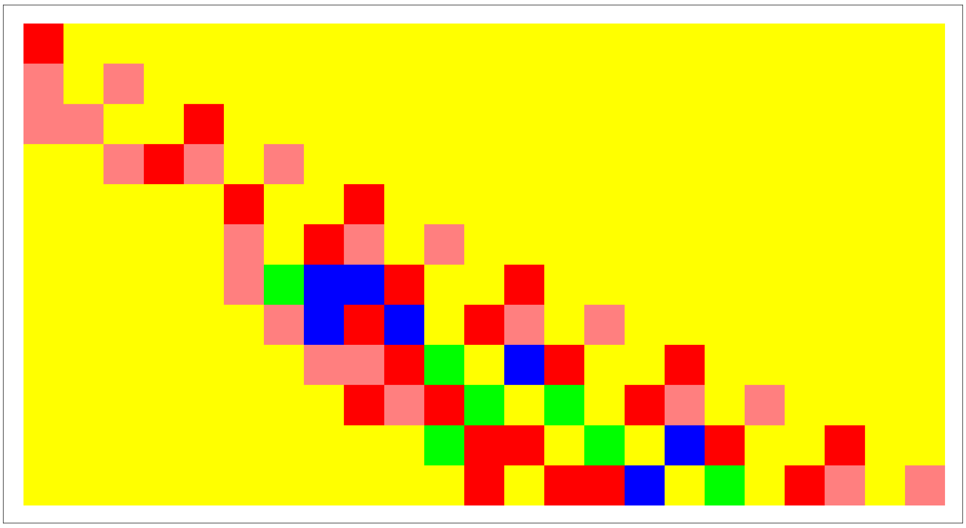


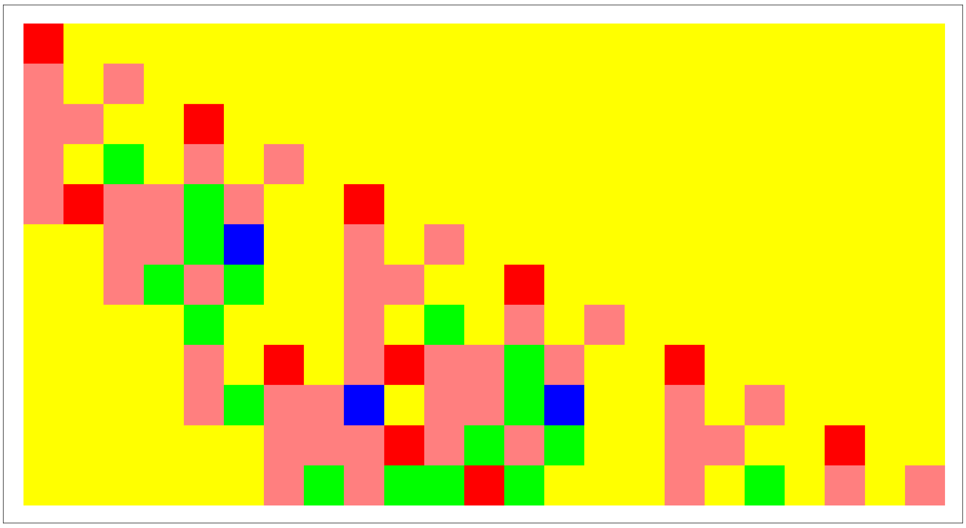


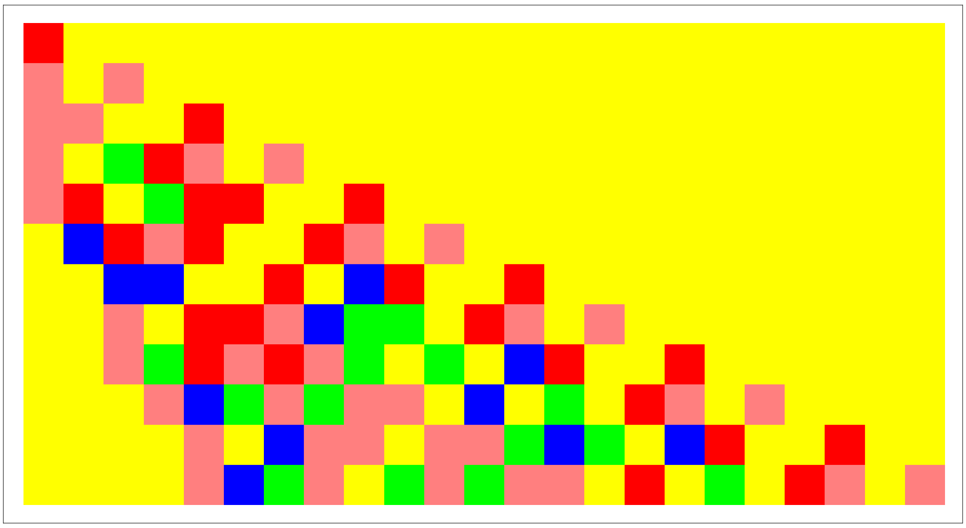


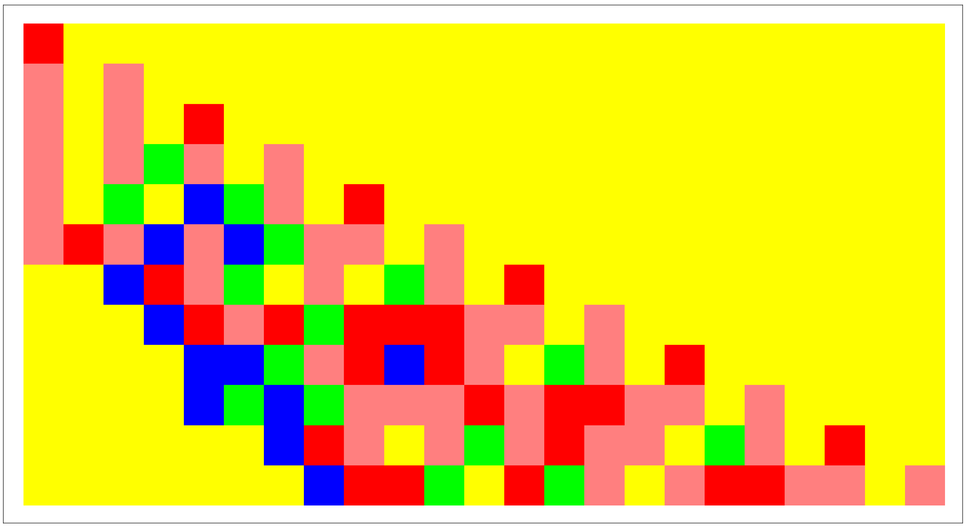




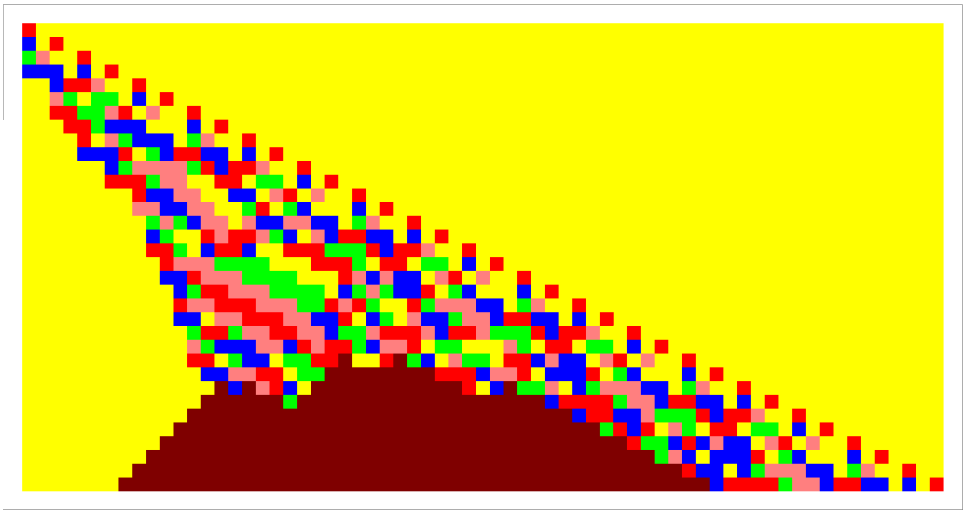


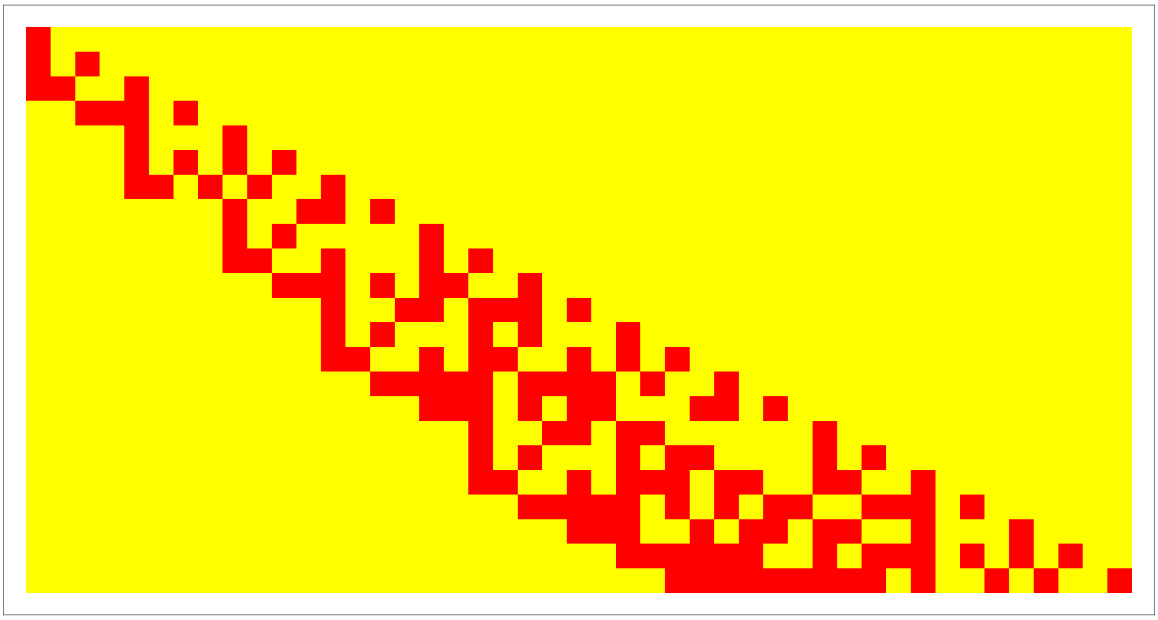


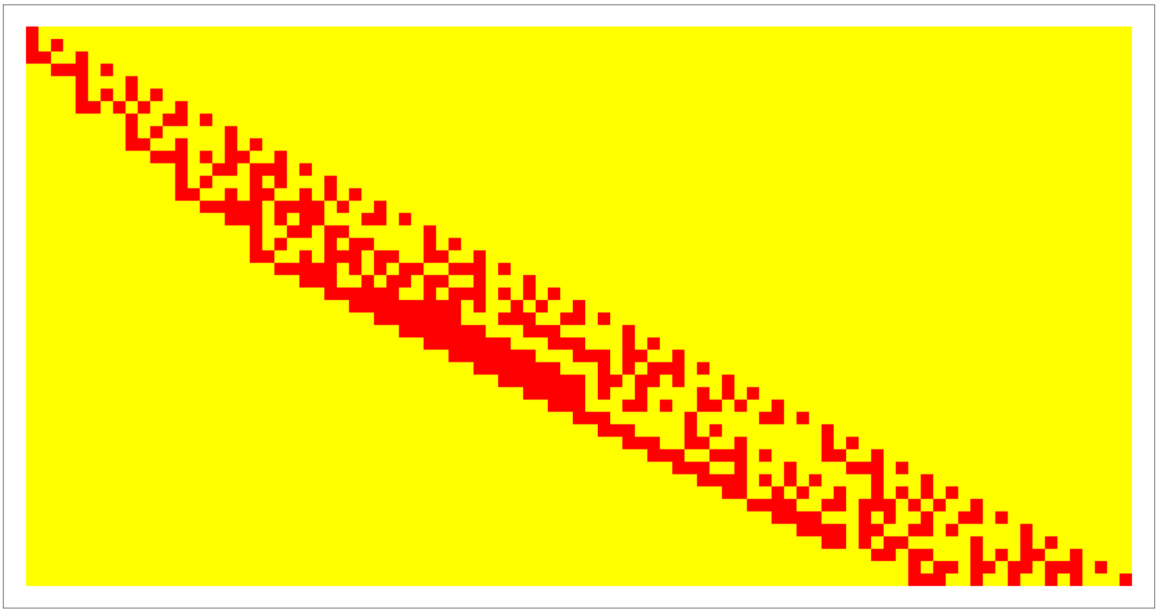


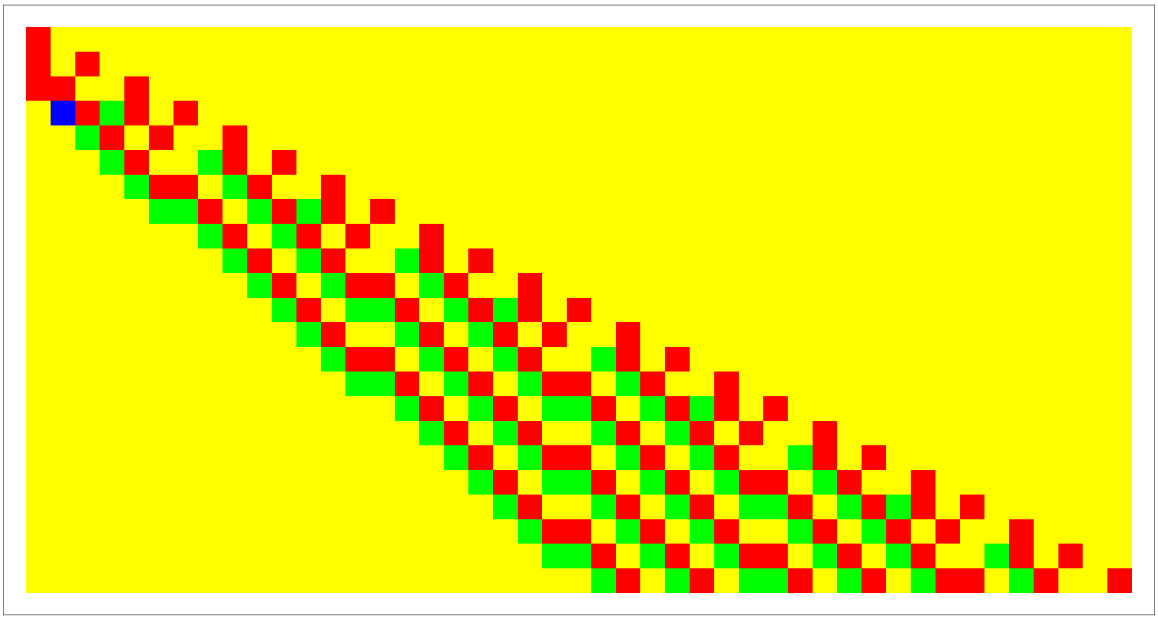


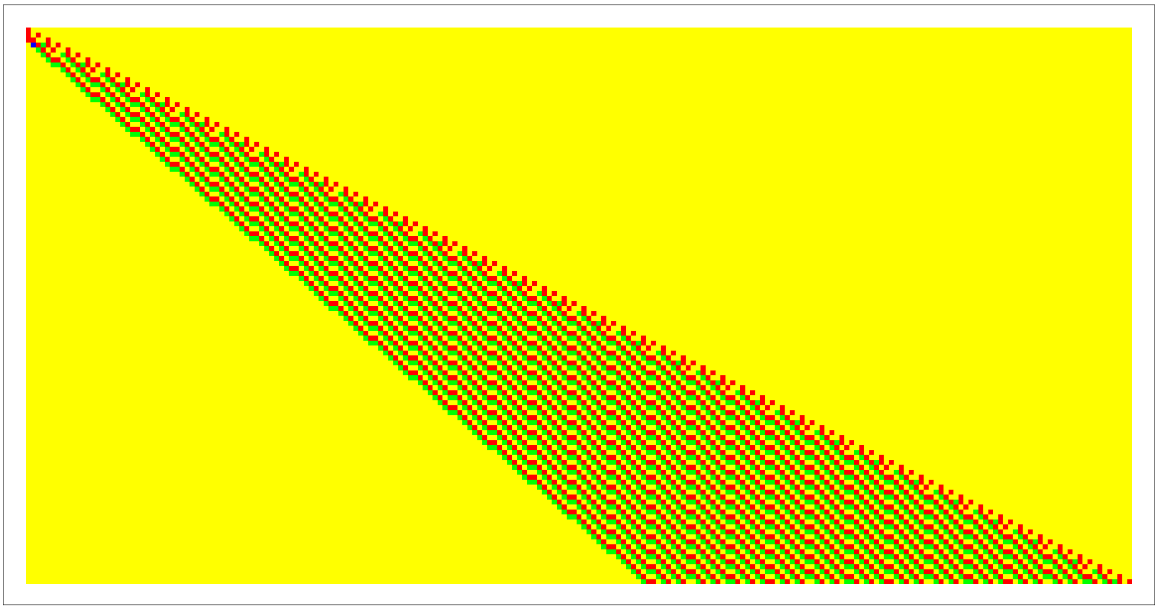
Complication of complexity measured by the steps of development

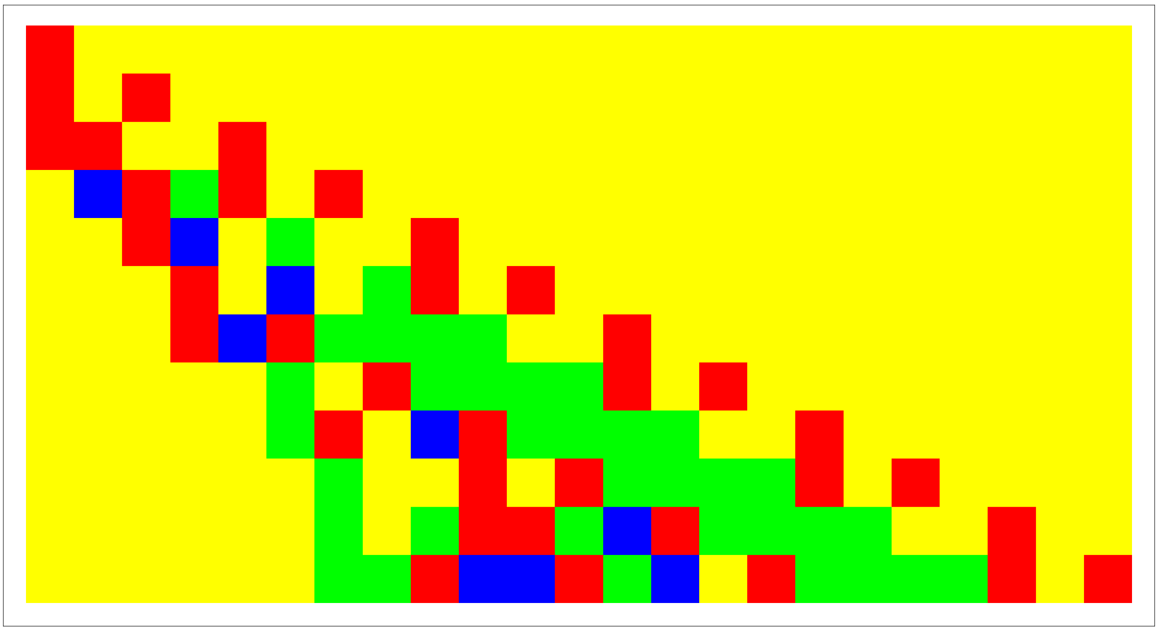


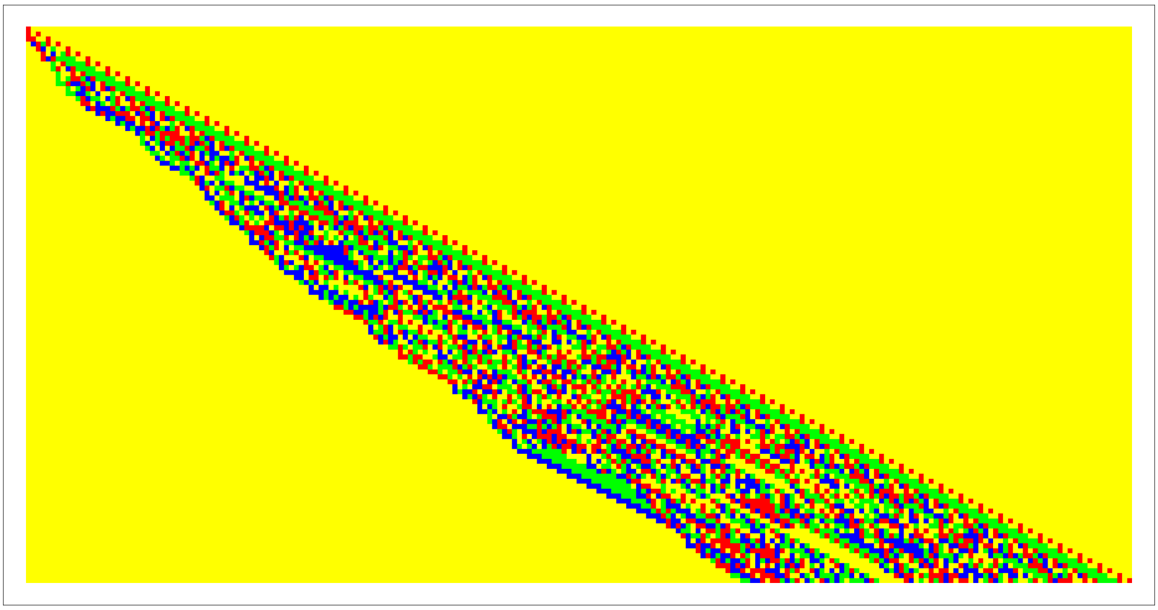


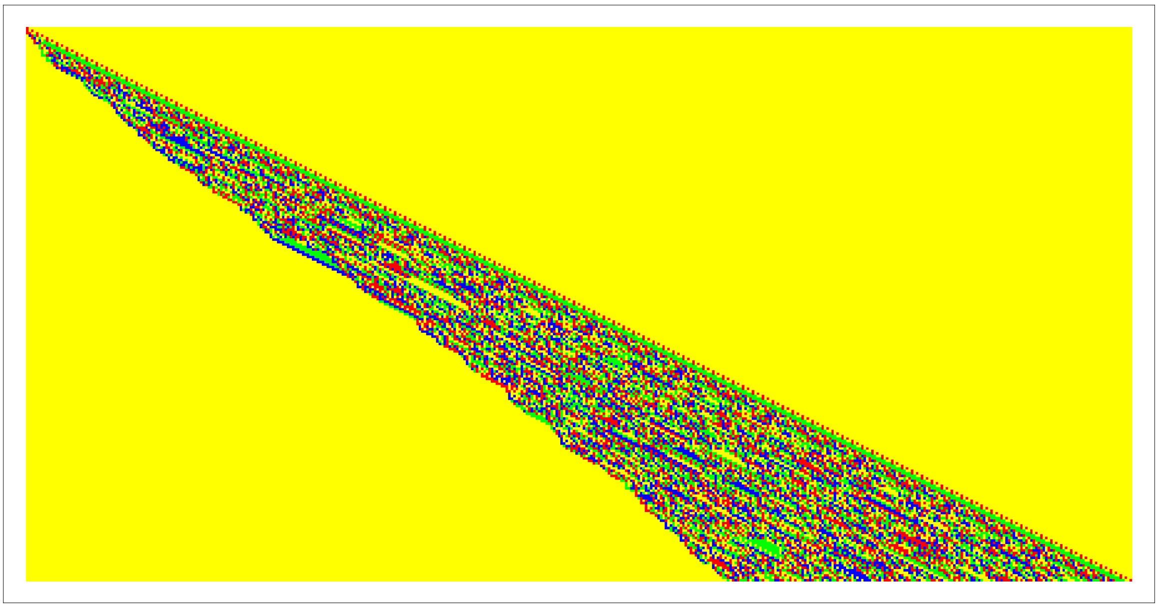




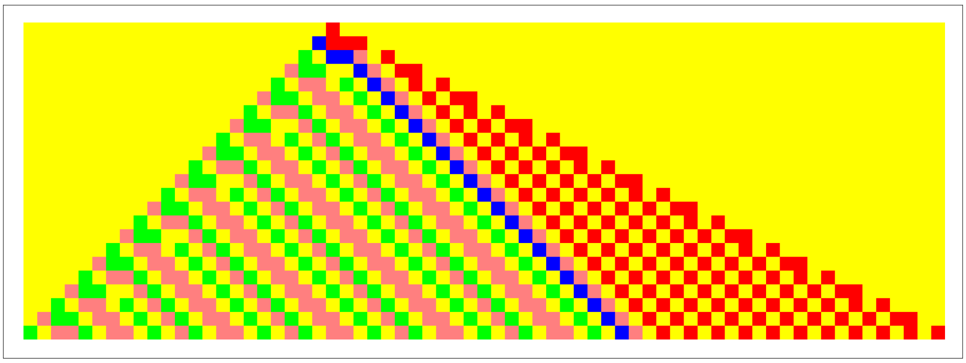


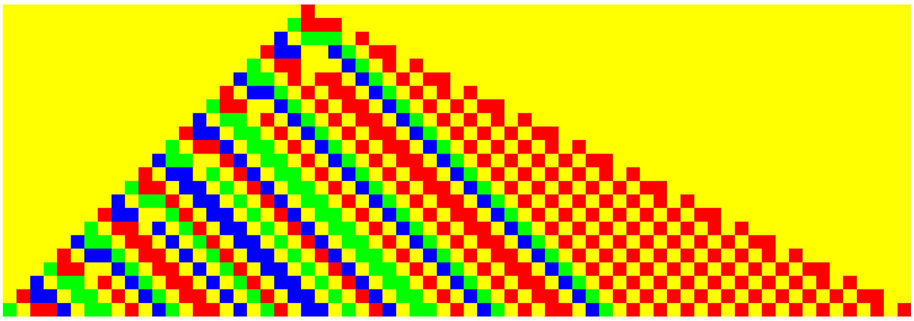


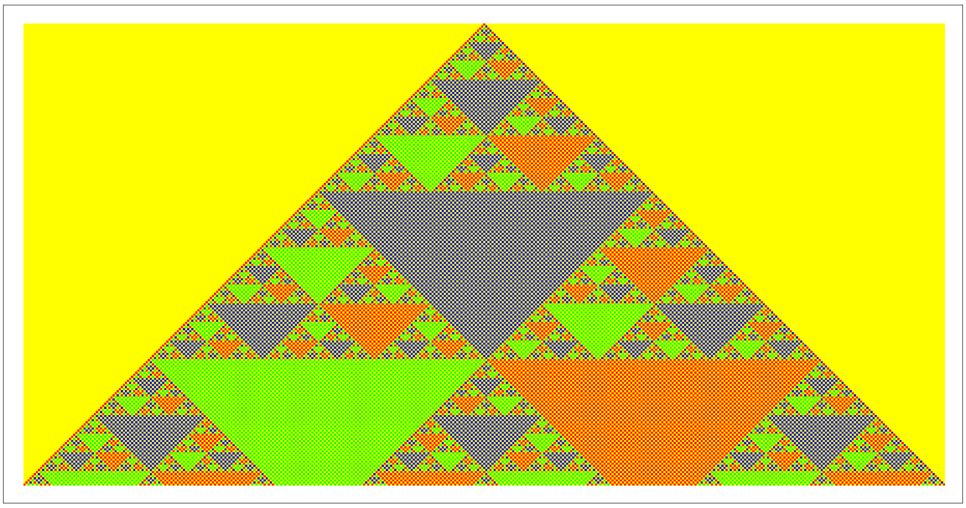




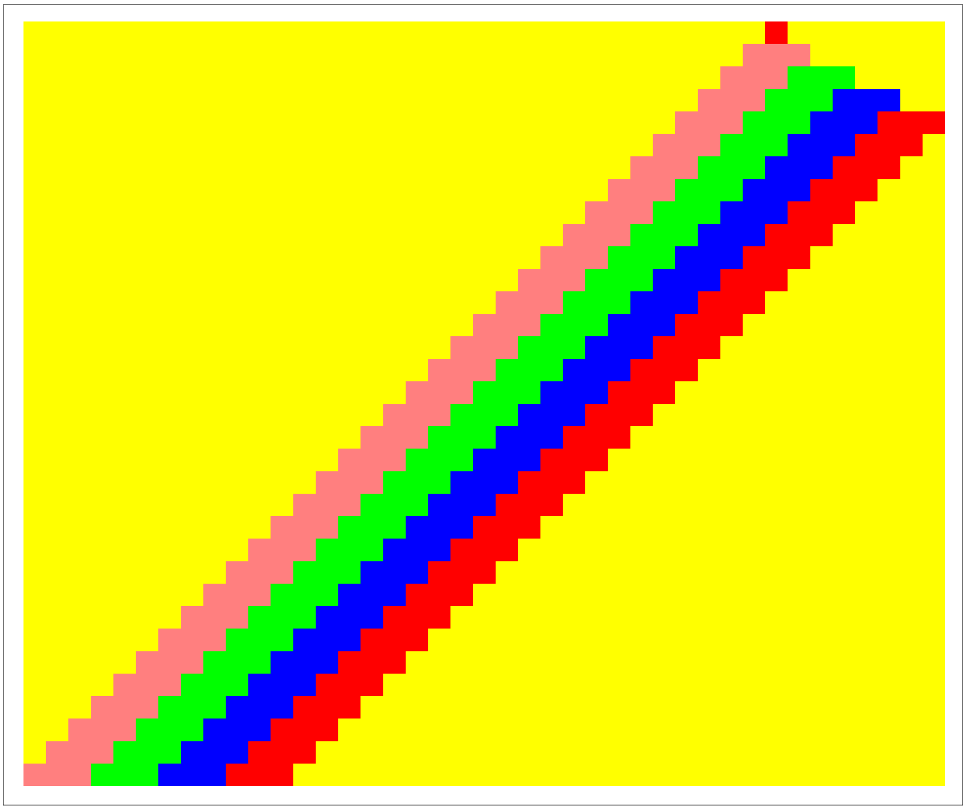
Overlapping

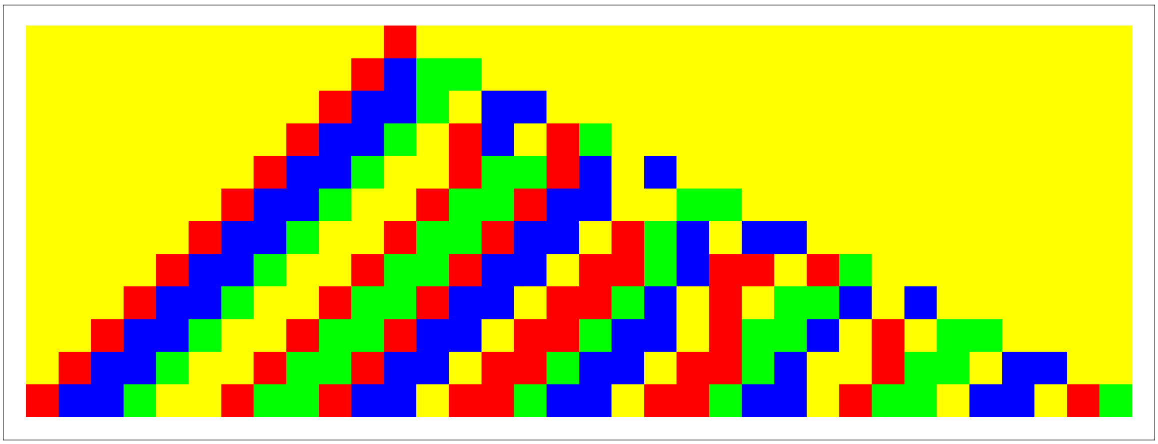




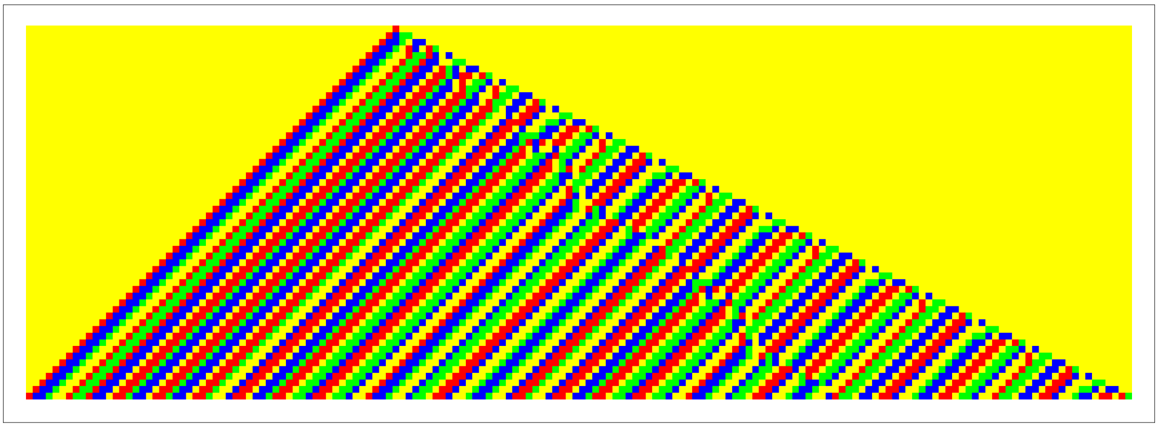


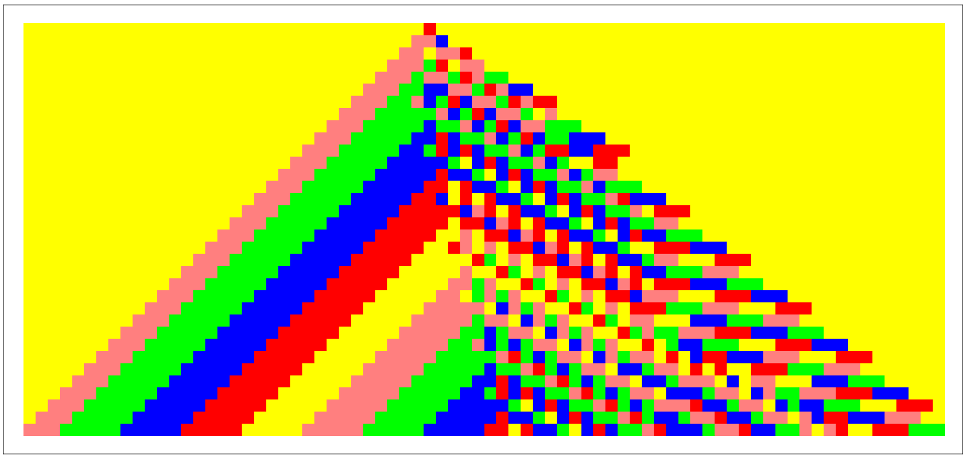
Parallelism

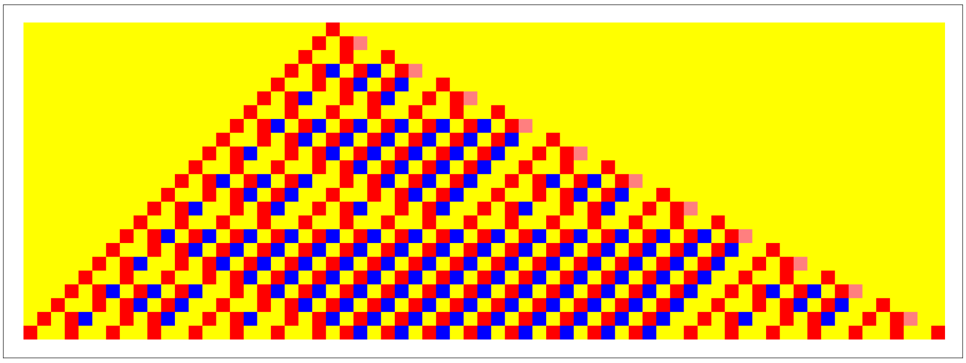


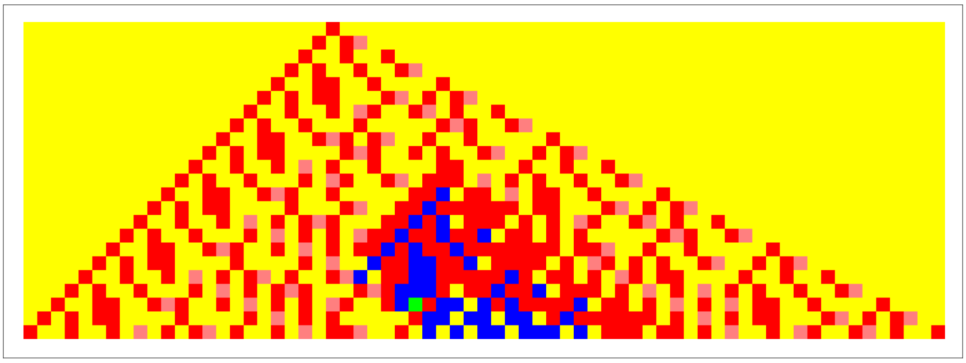


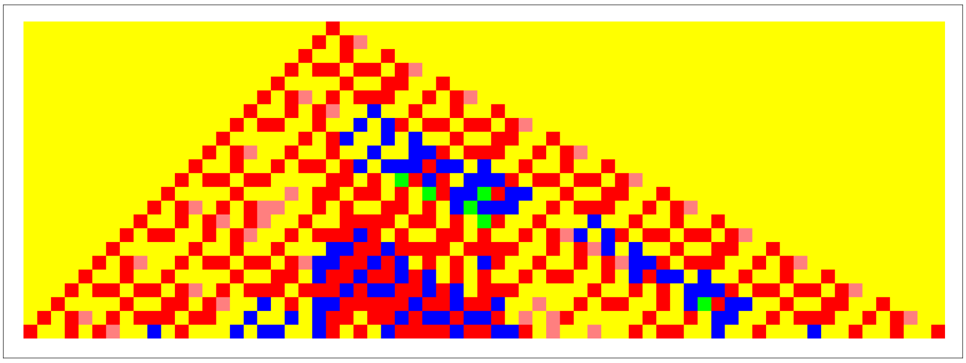
Mixtures







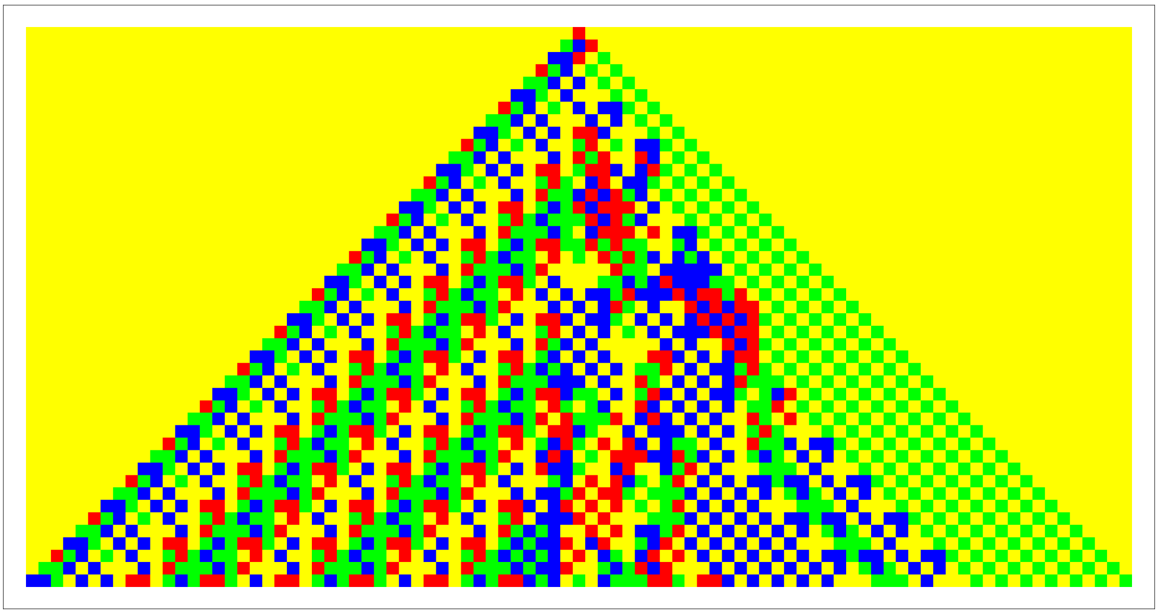


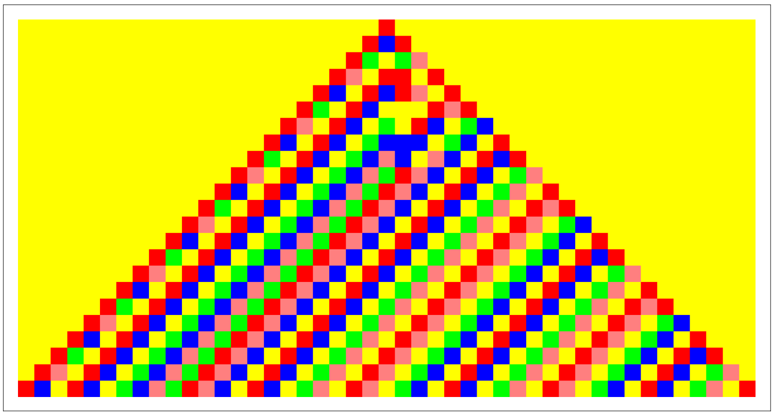


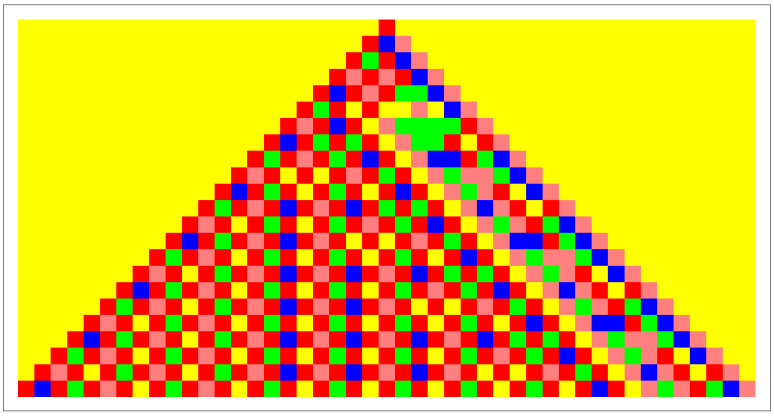
Examples for ruleDCKV

Some examples out of the rule space of *ruleDCKV* with 2x3^7x4^6 x 5 = 89’579’520 possible constellations.

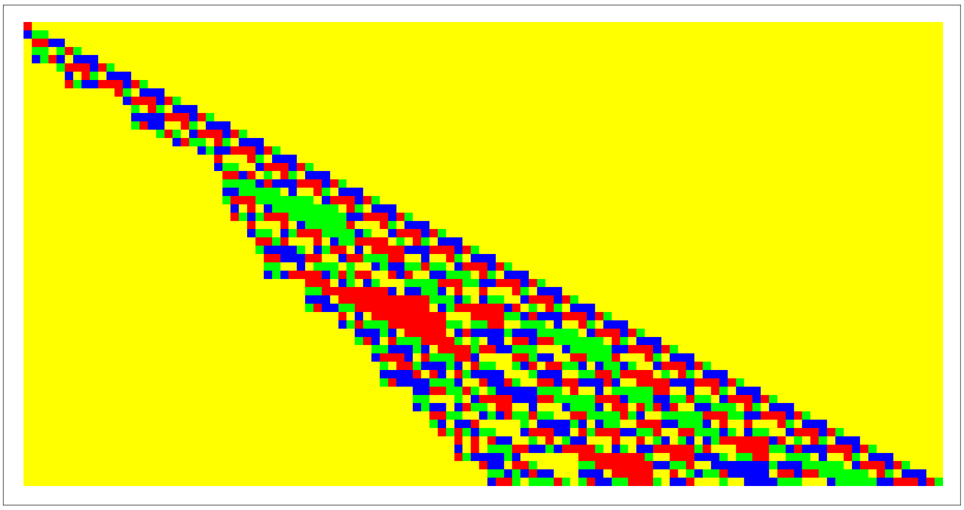
symmetric

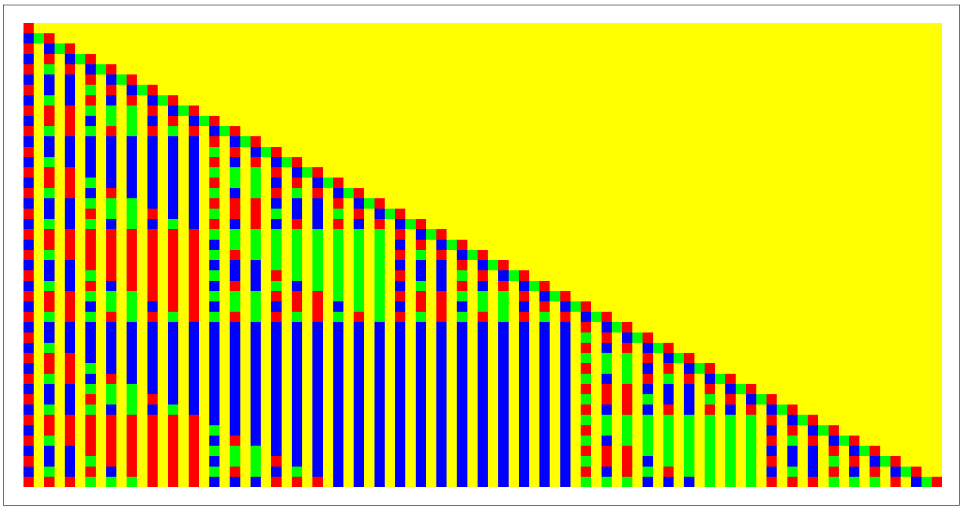


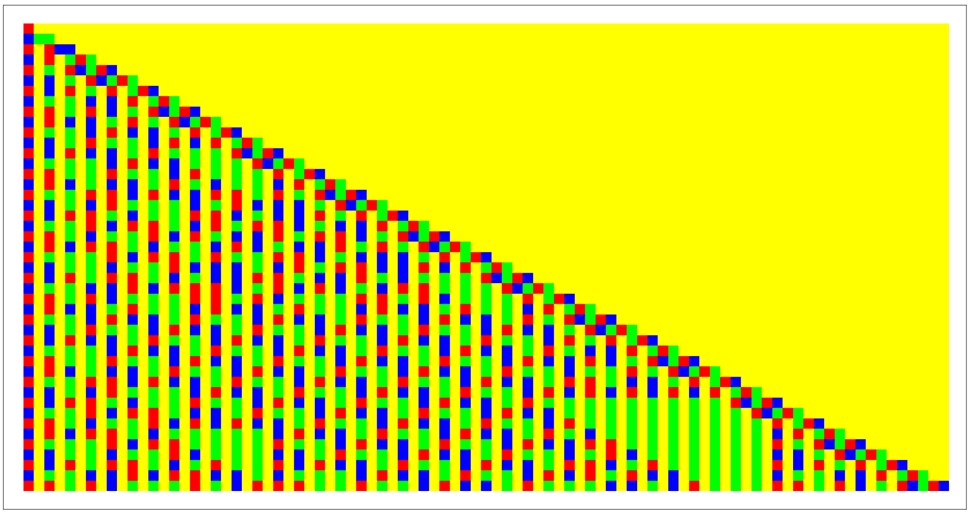


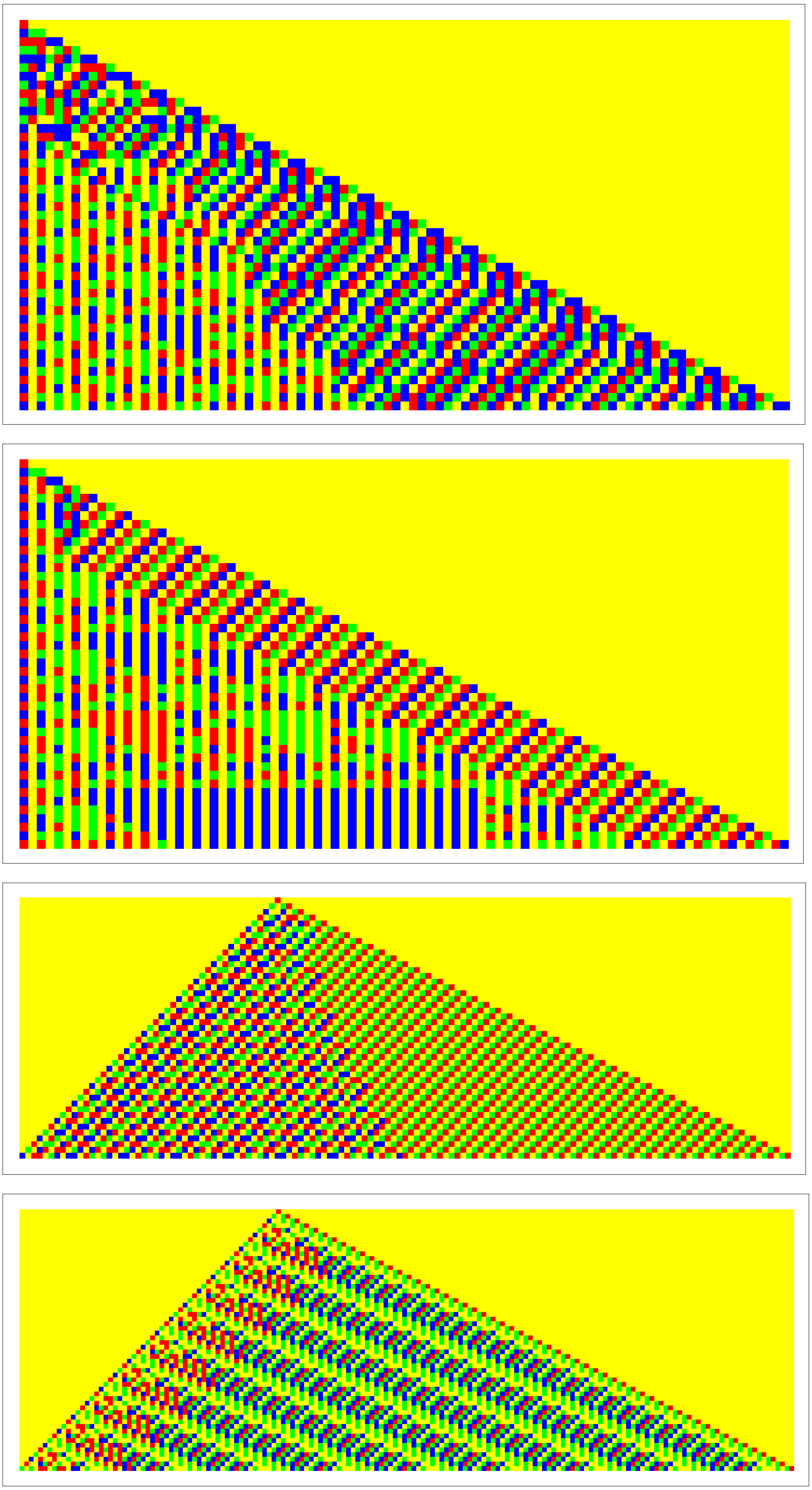


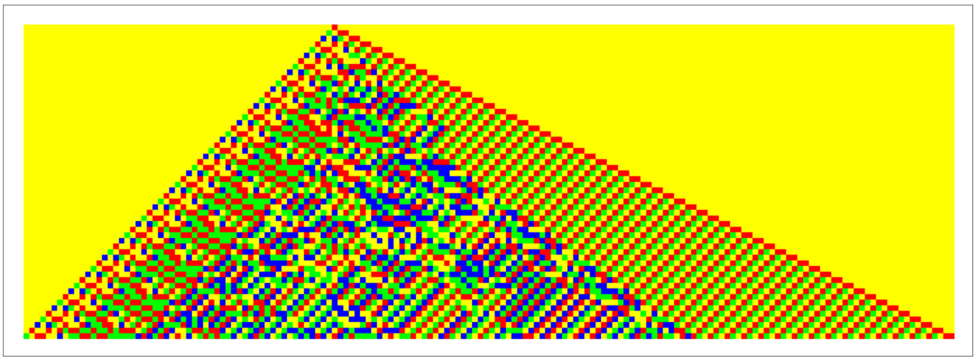
asymmetric

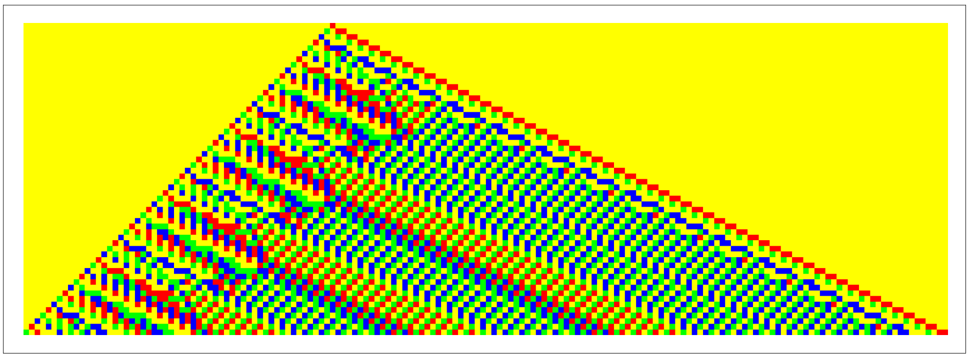


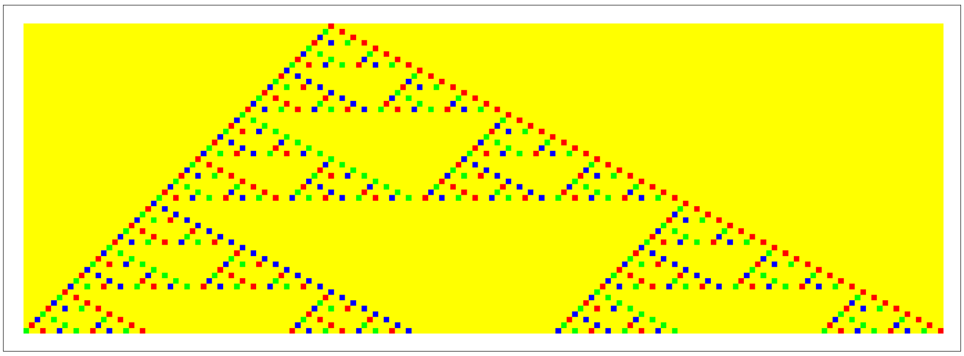


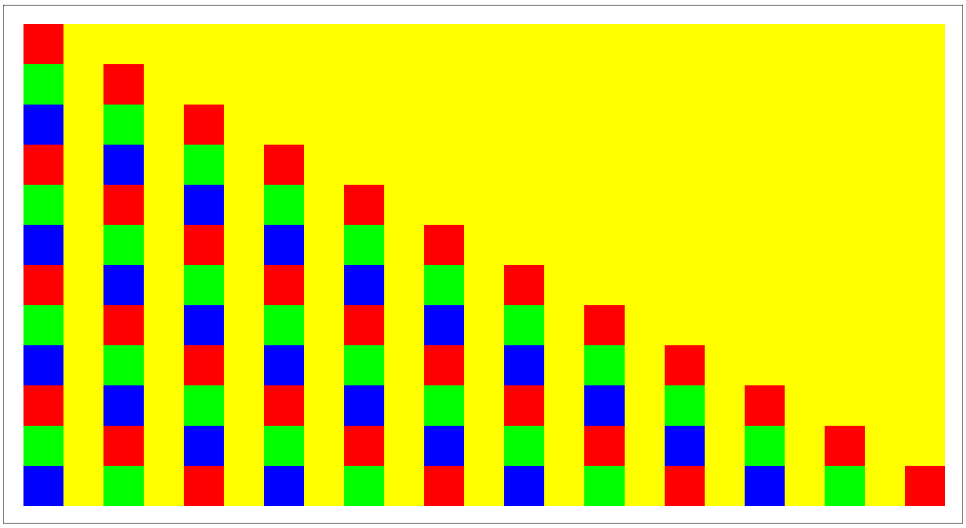


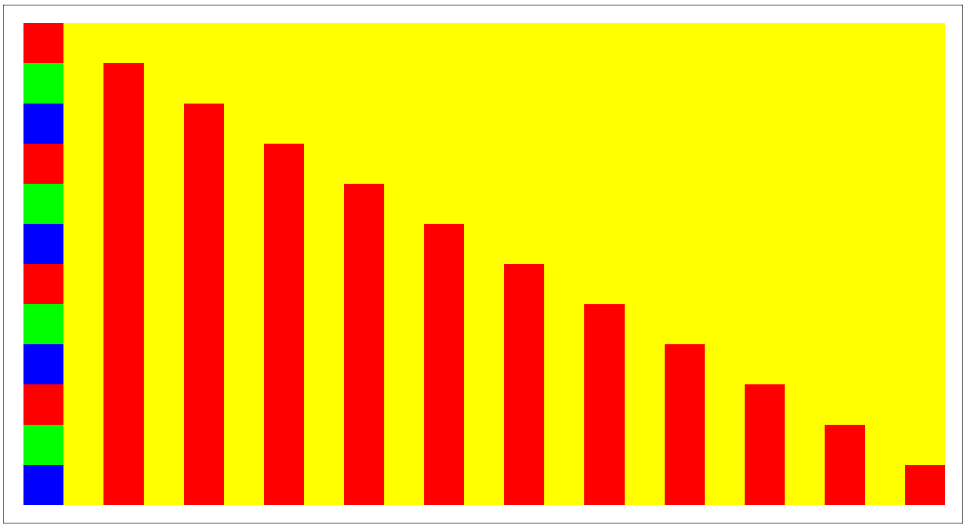


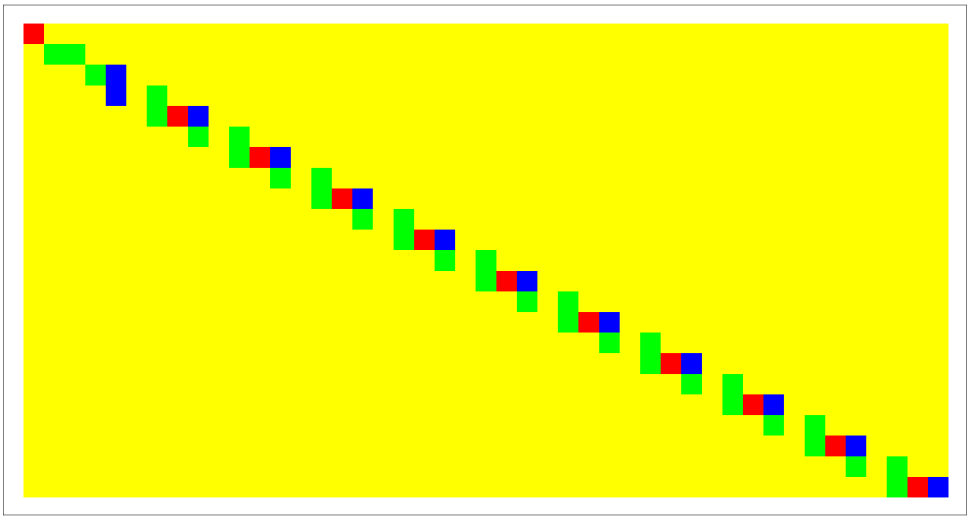


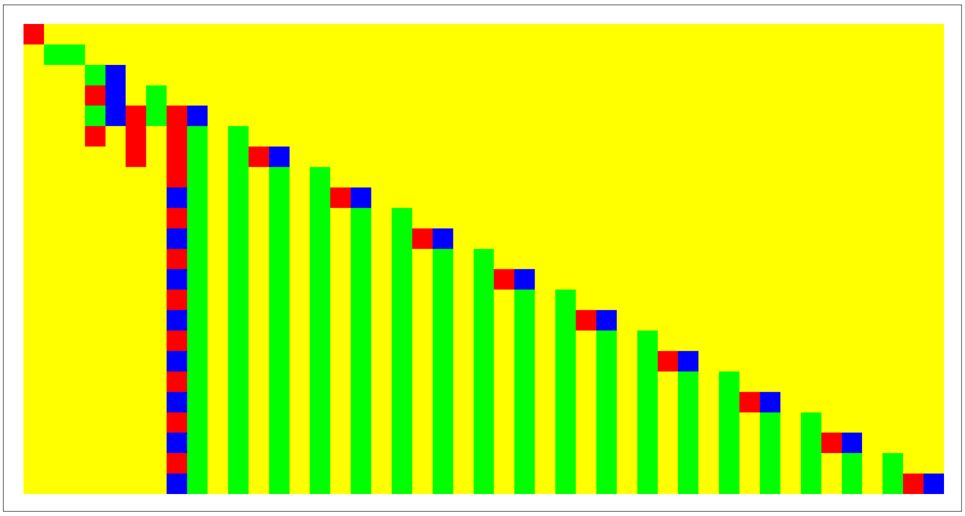


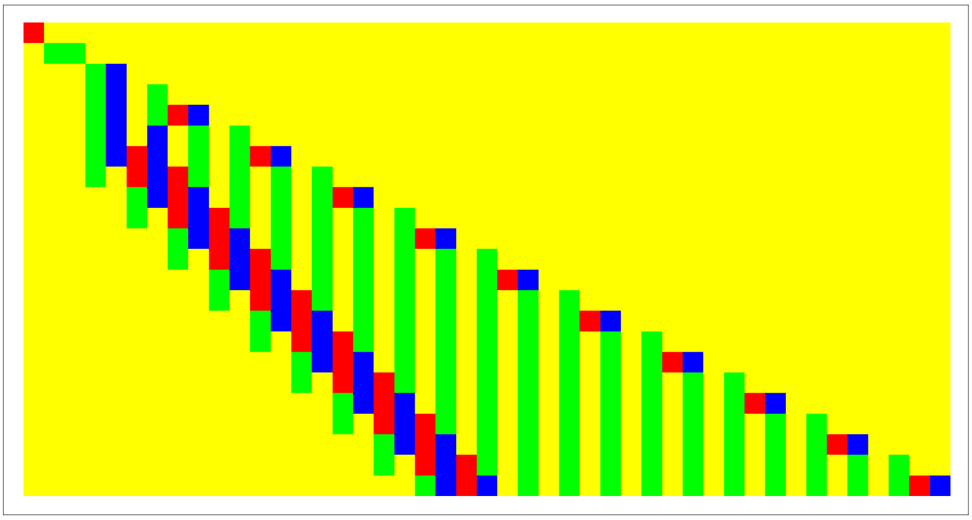


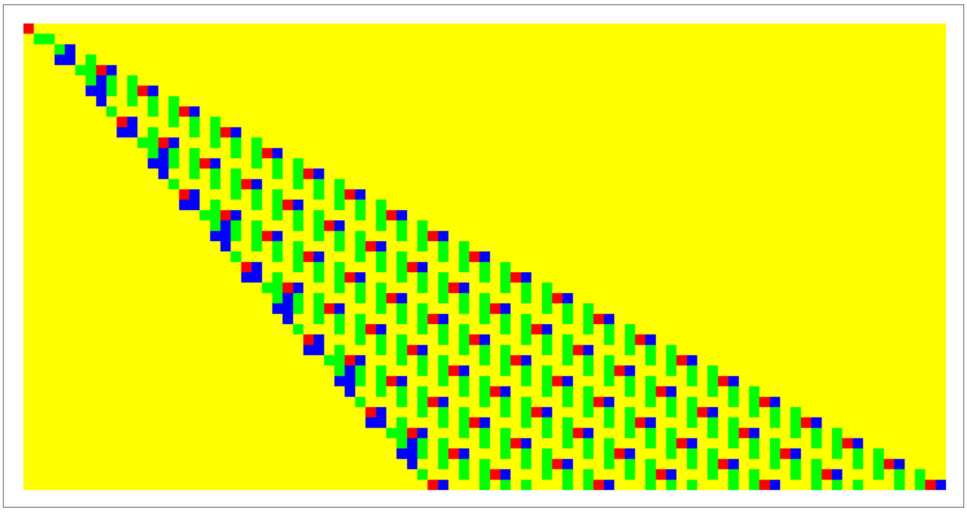


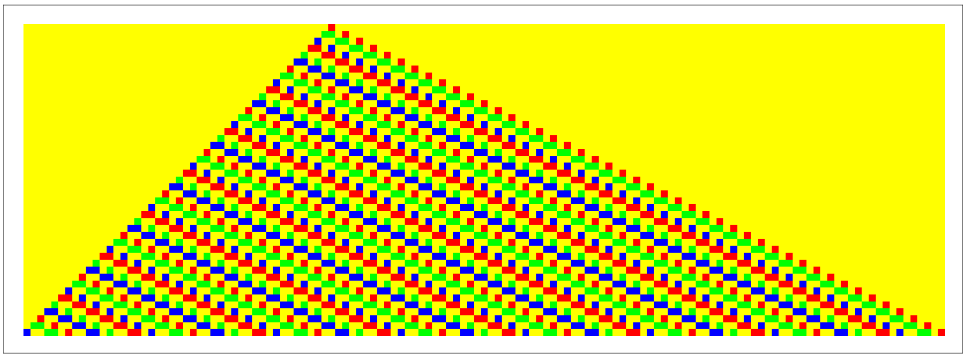


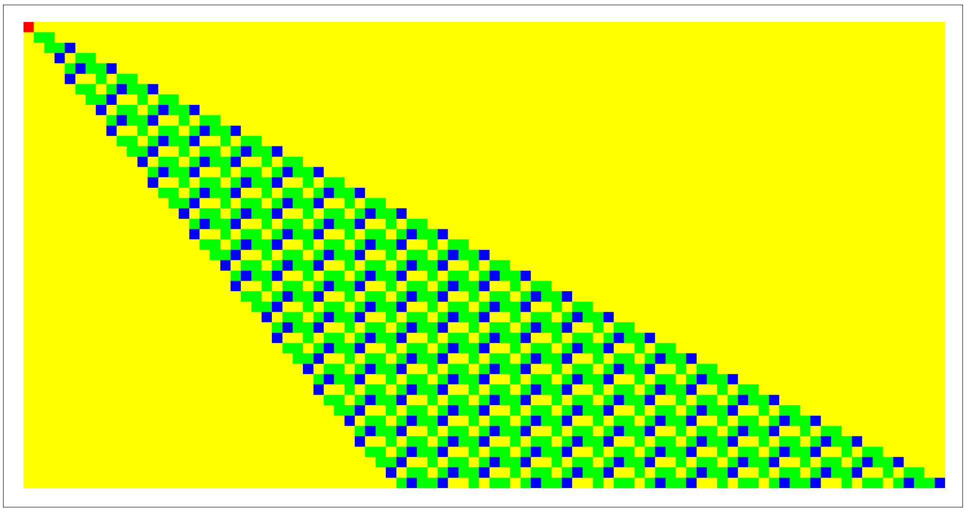


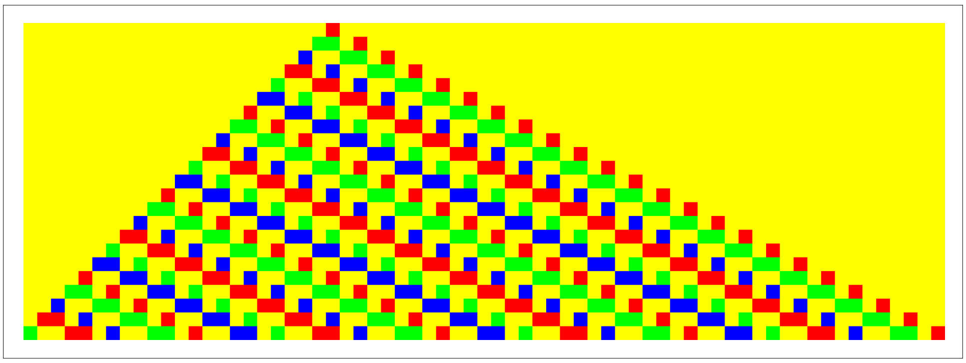


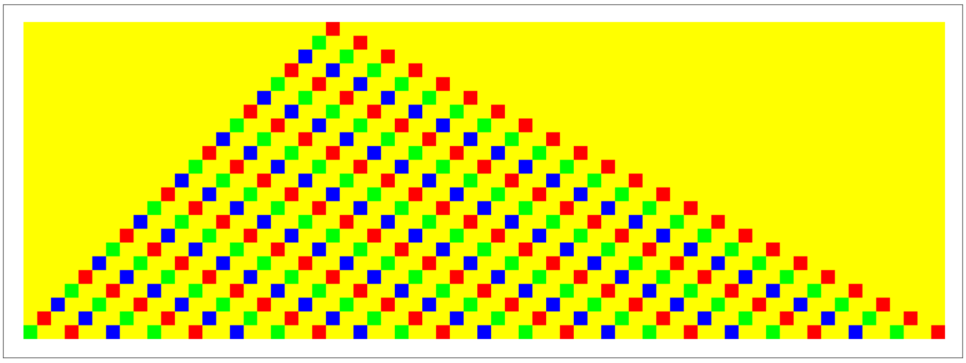


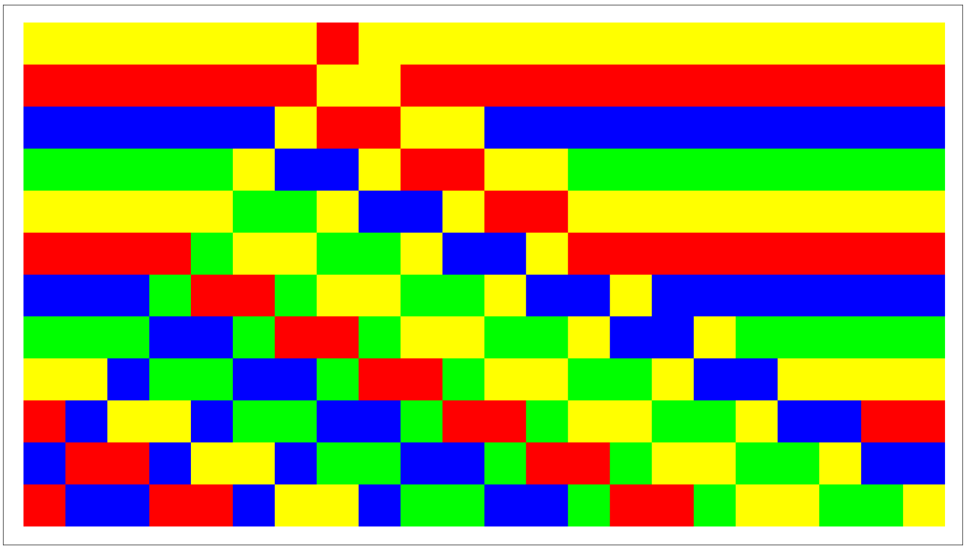


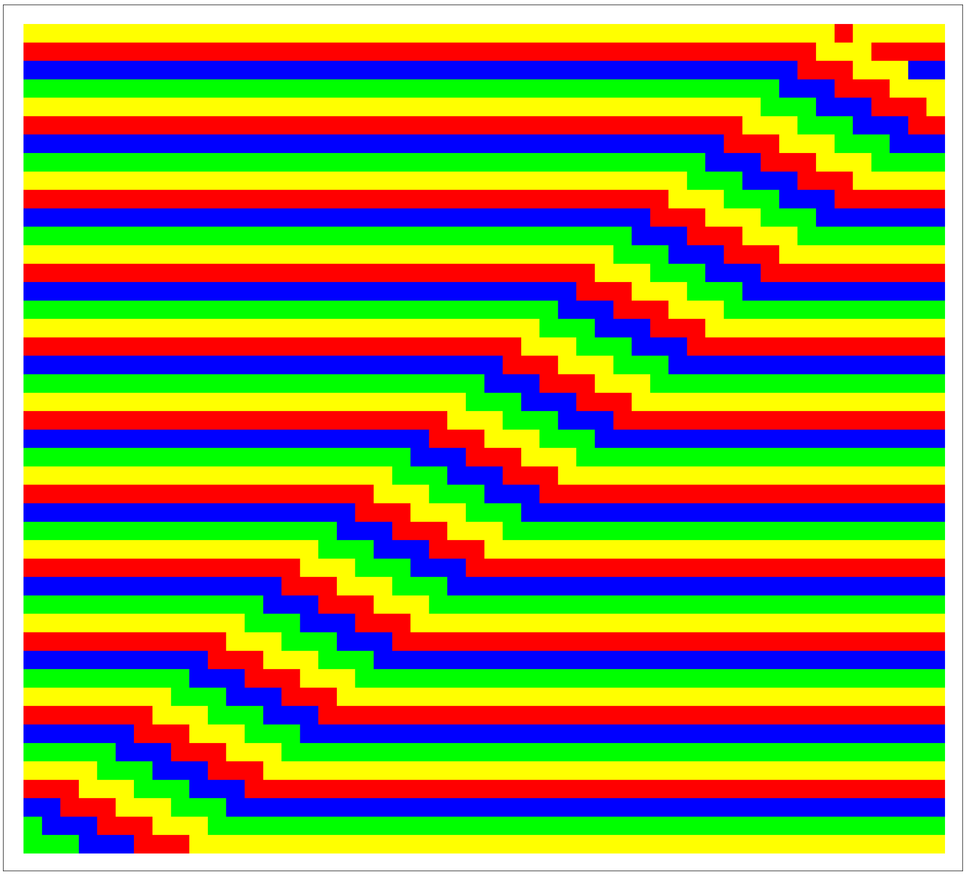




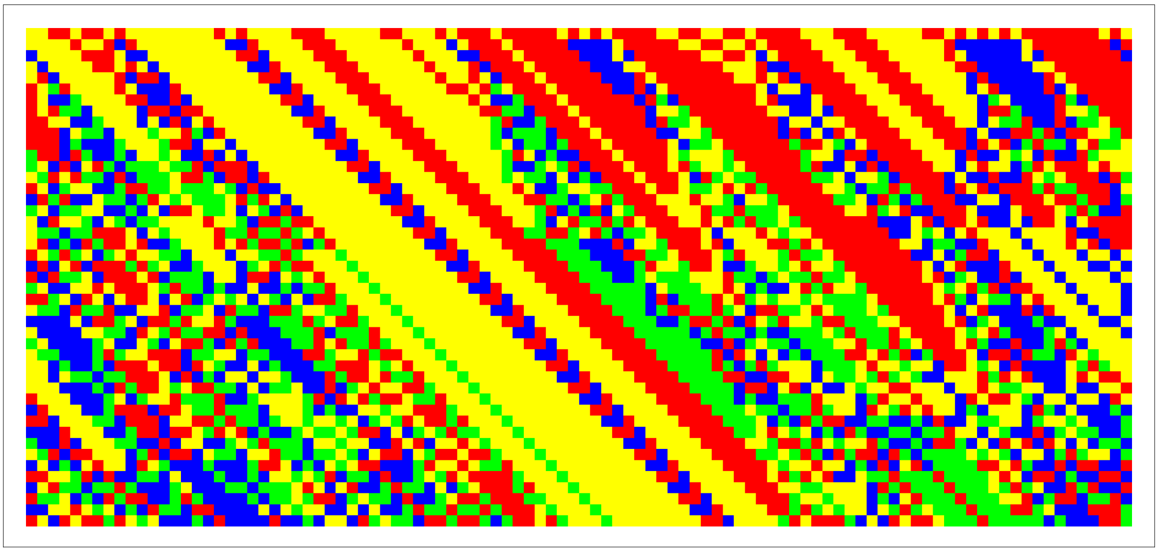


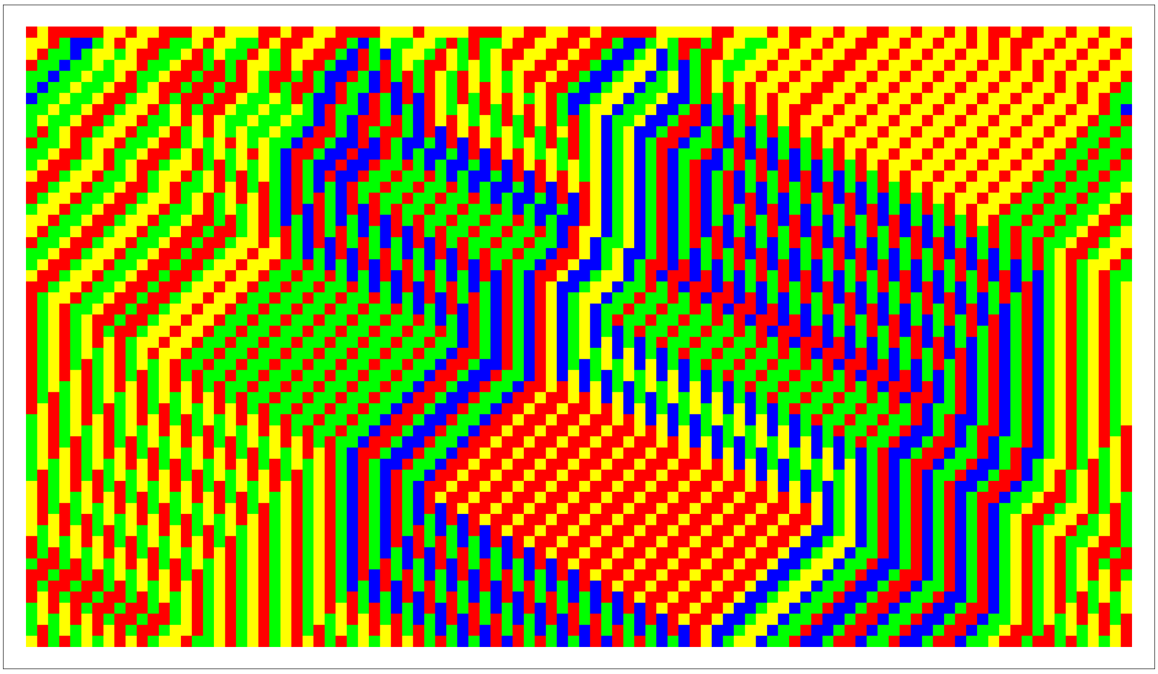


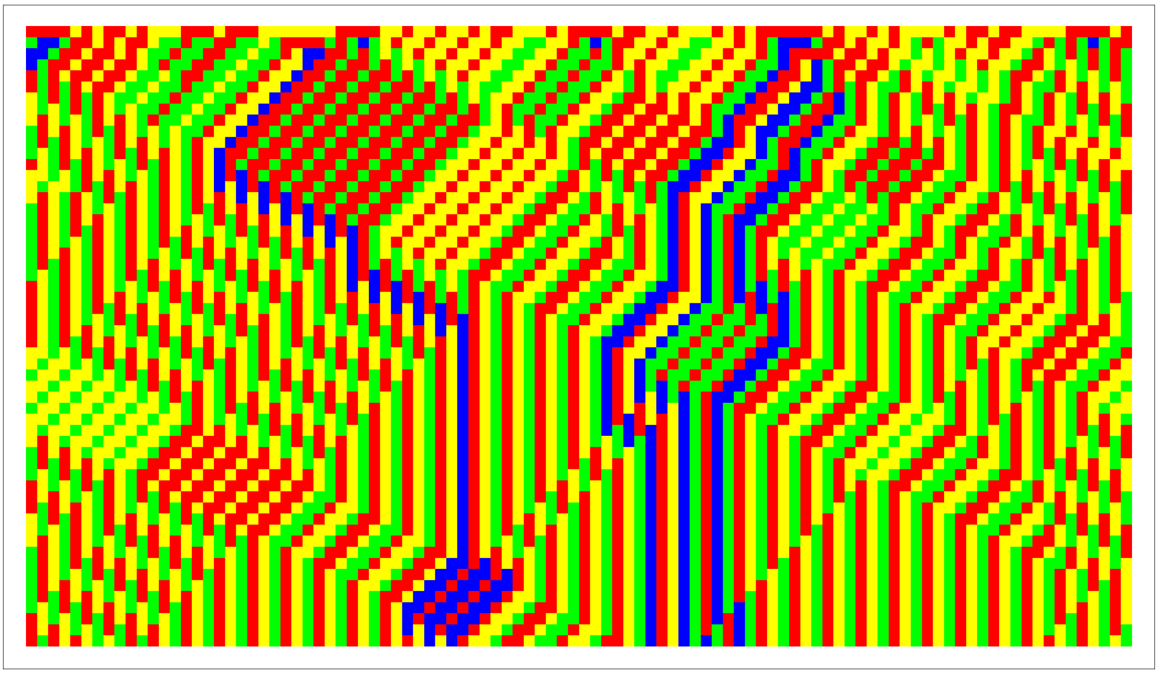


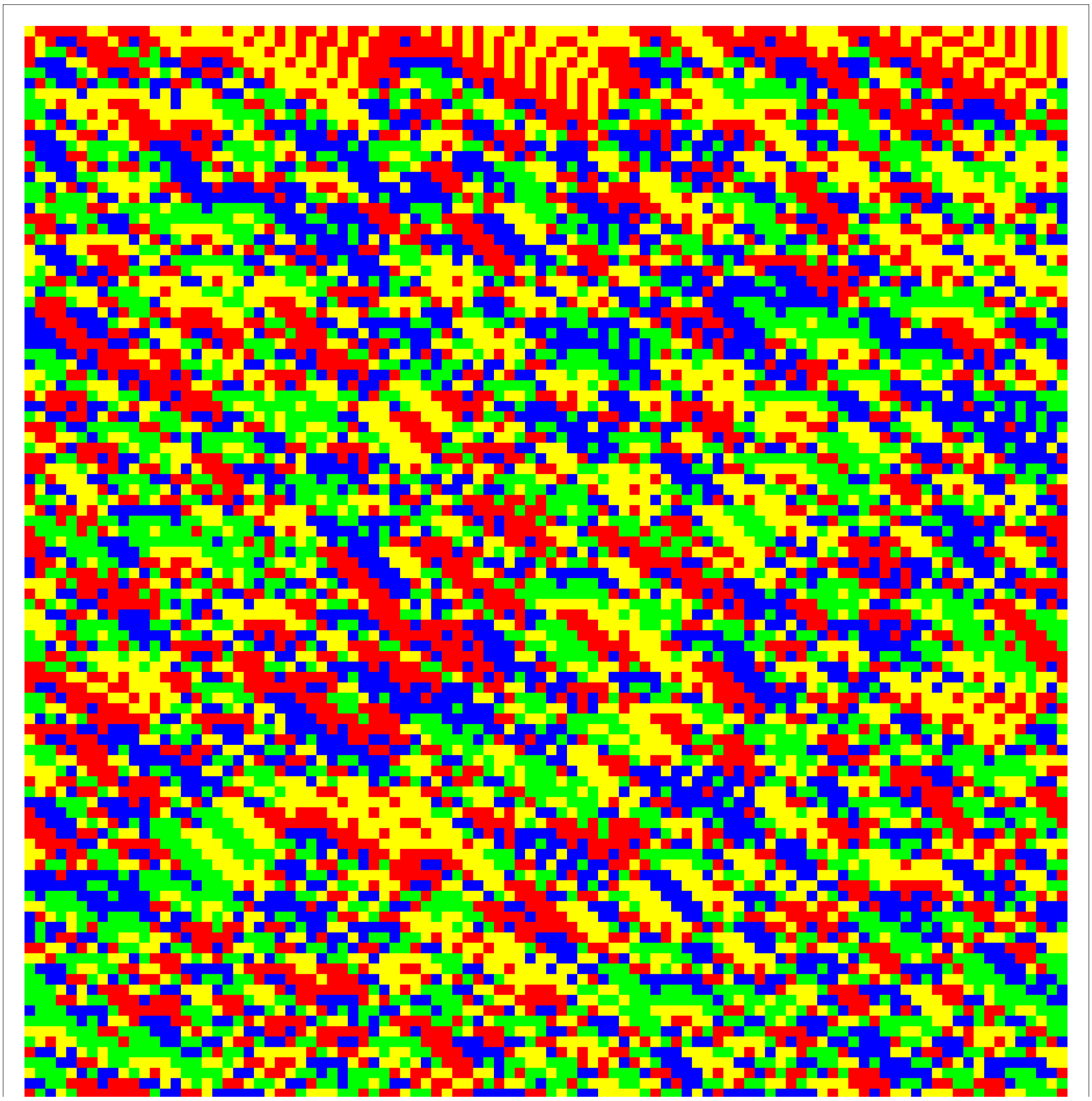


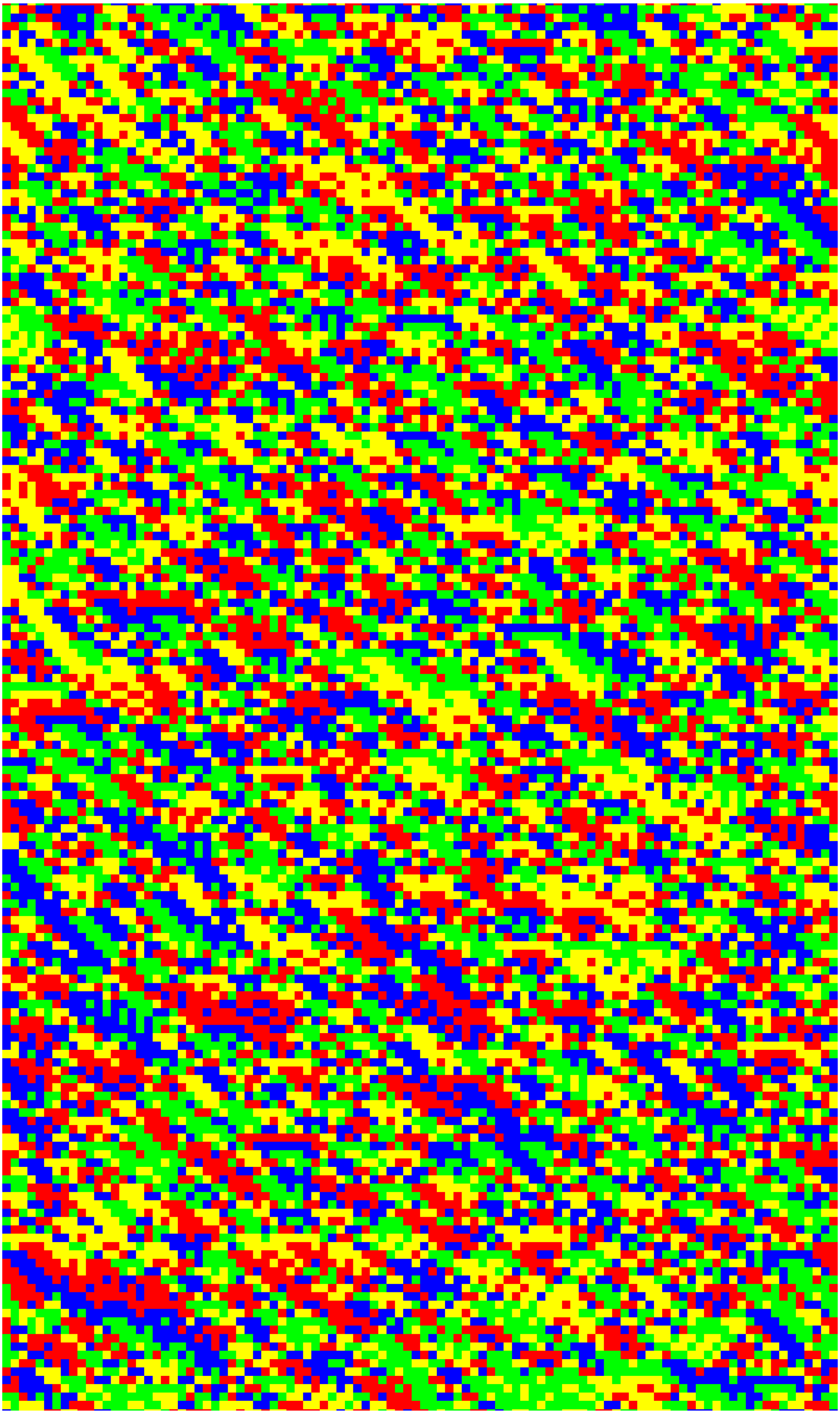
Examples for ruleDCKV, Random

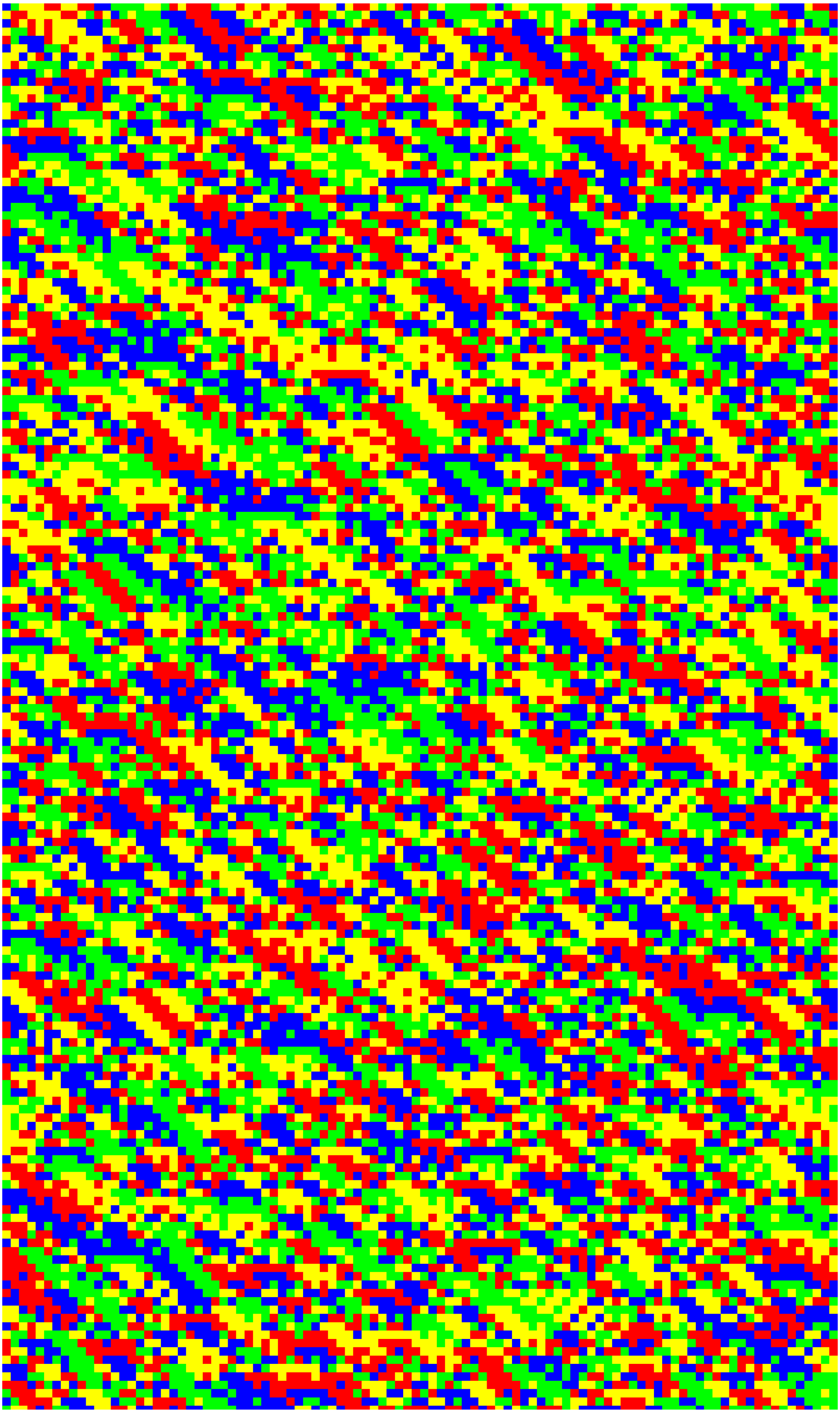


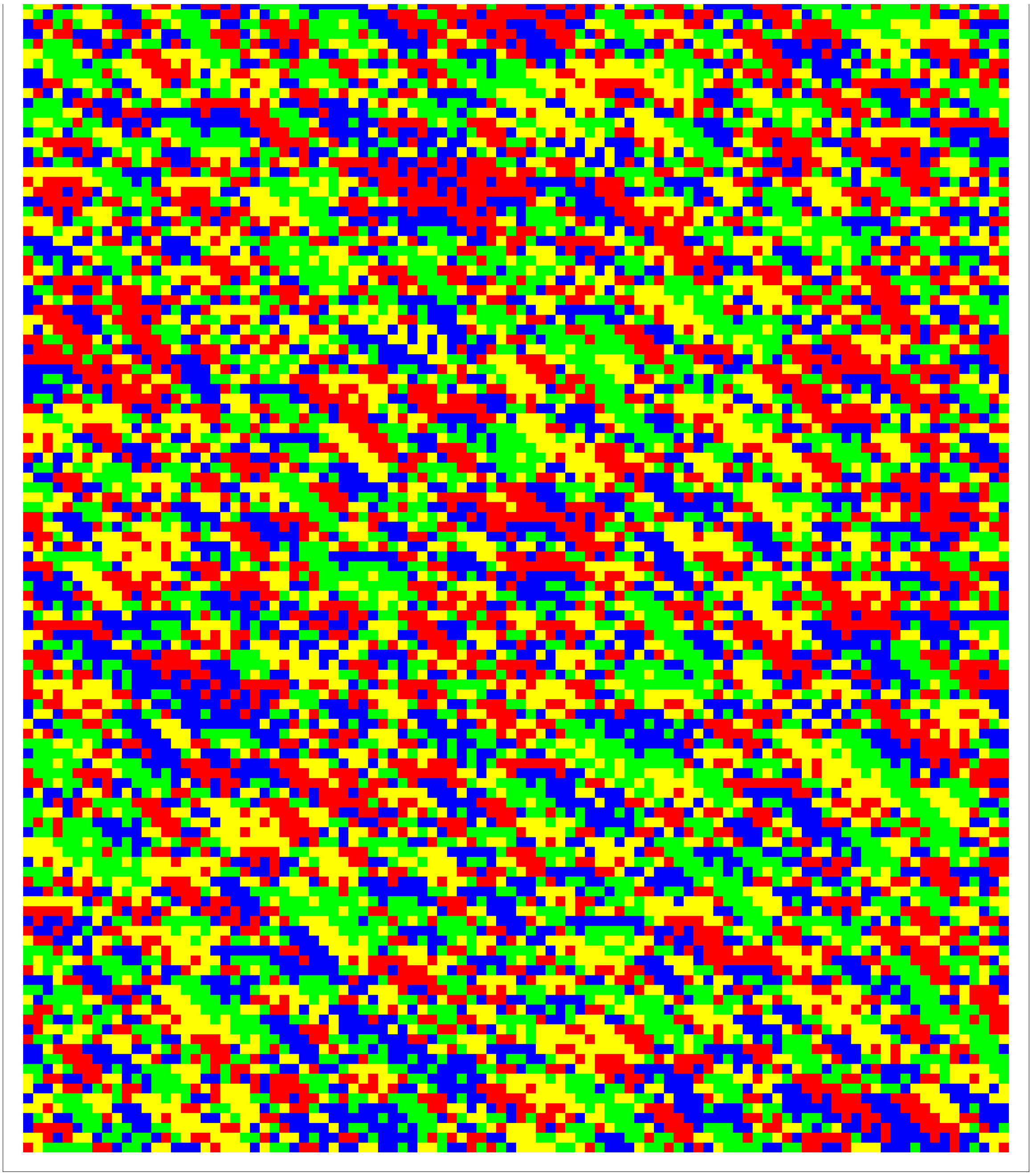


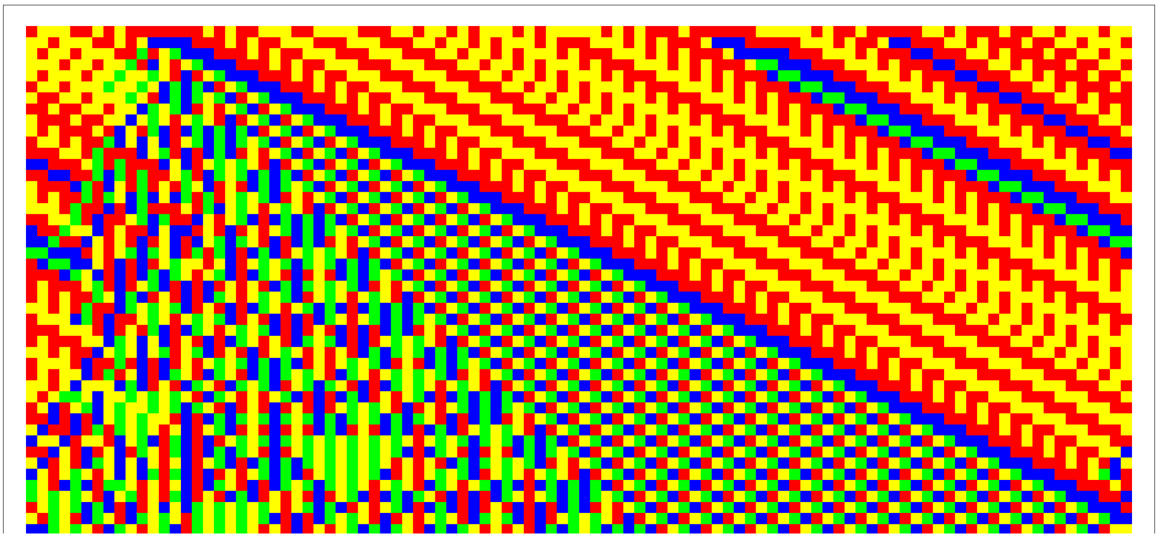


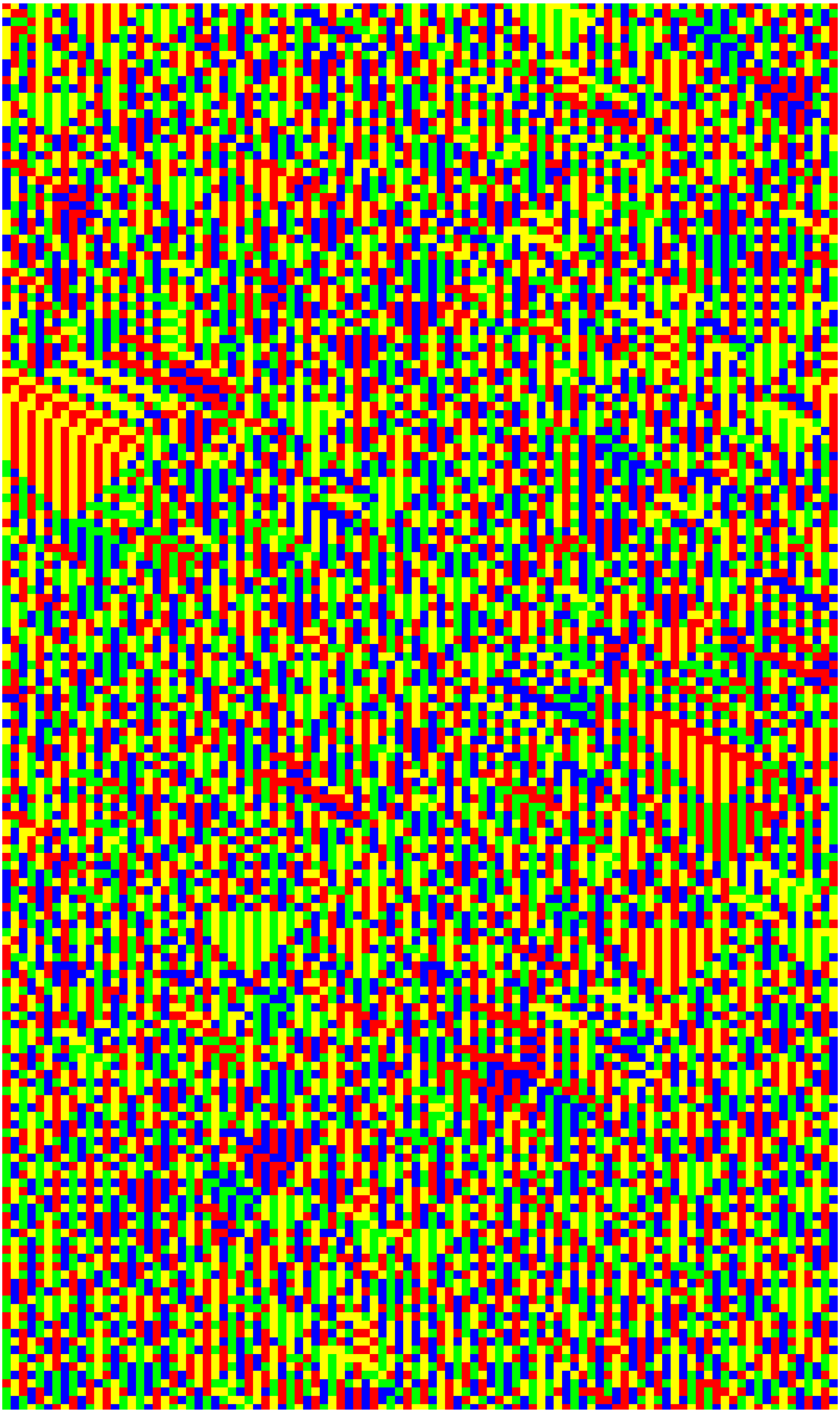


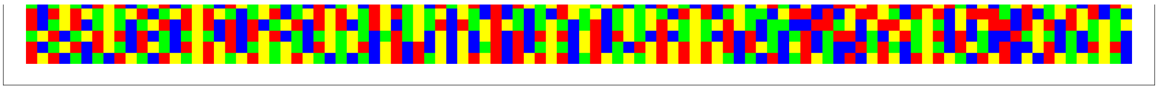


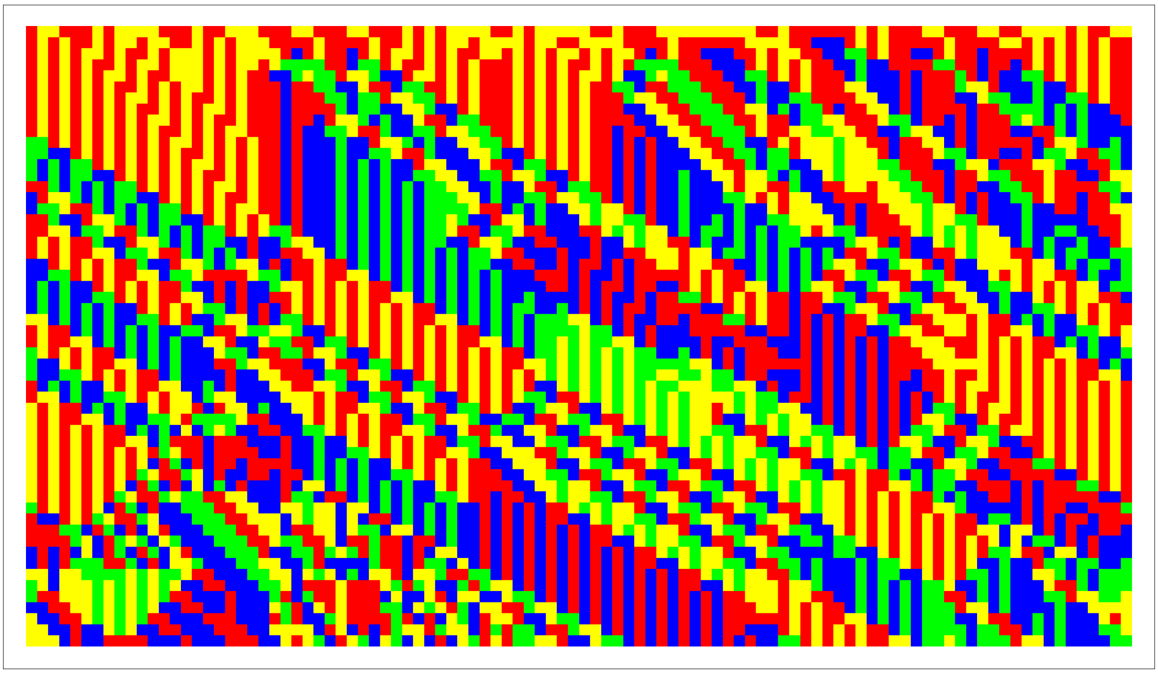


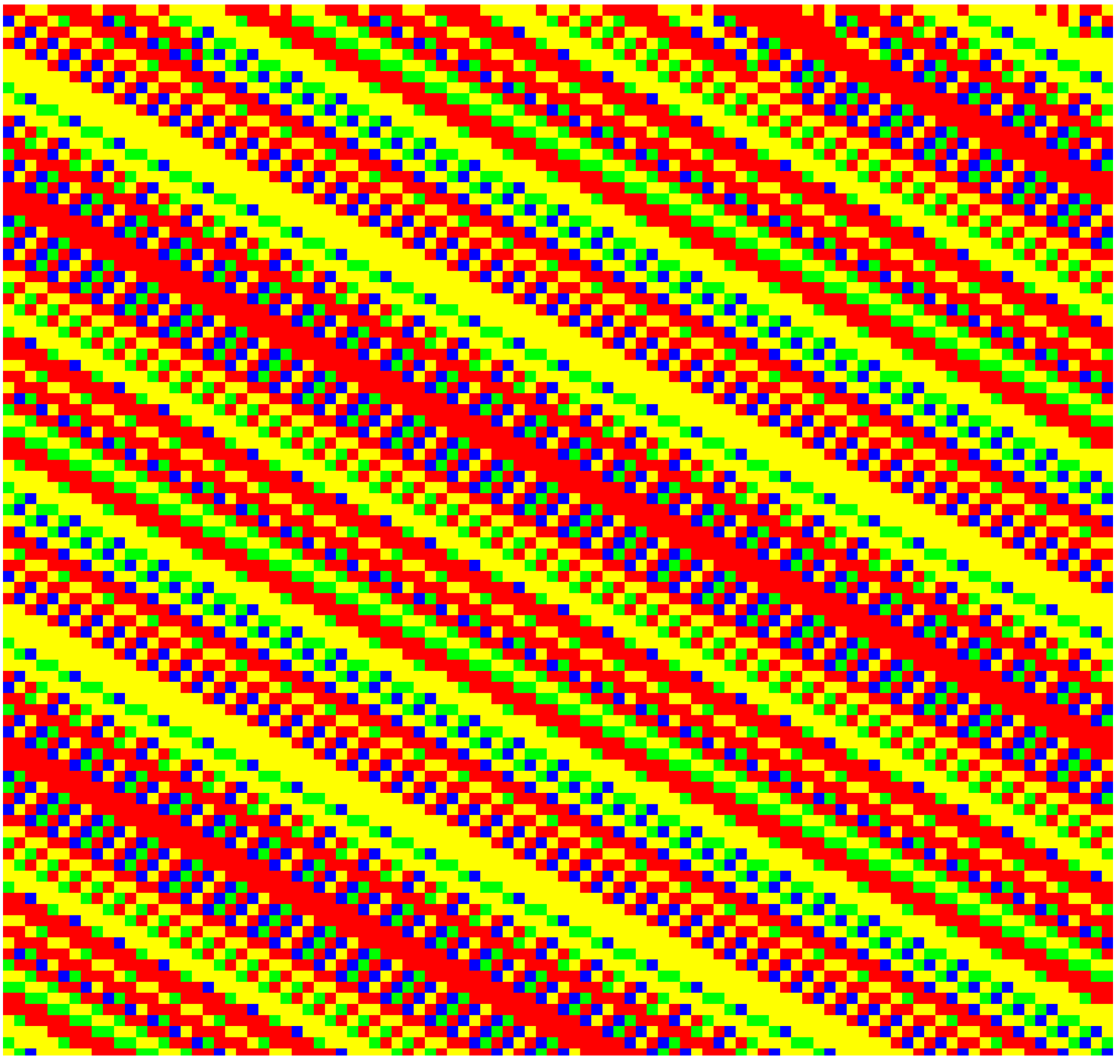


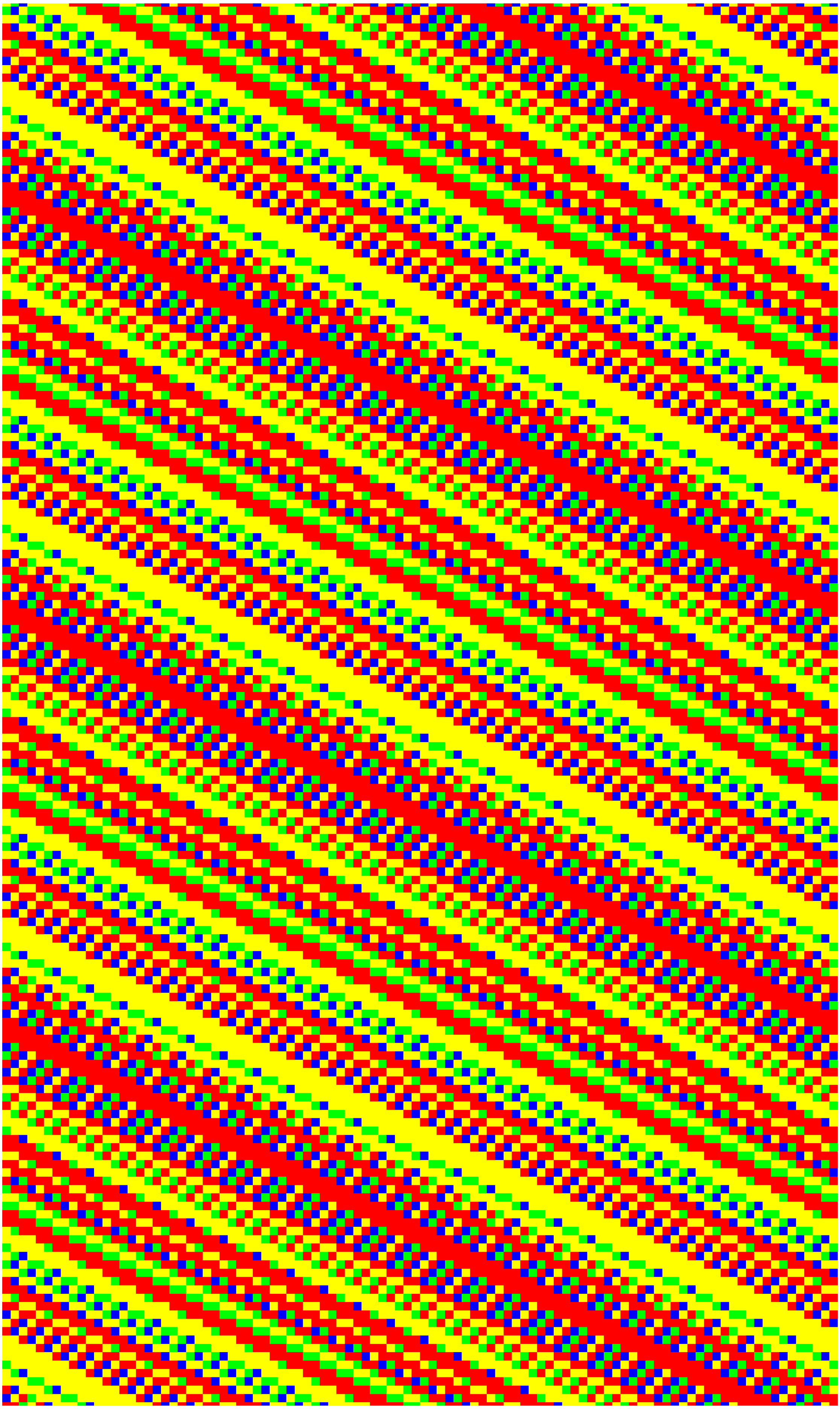


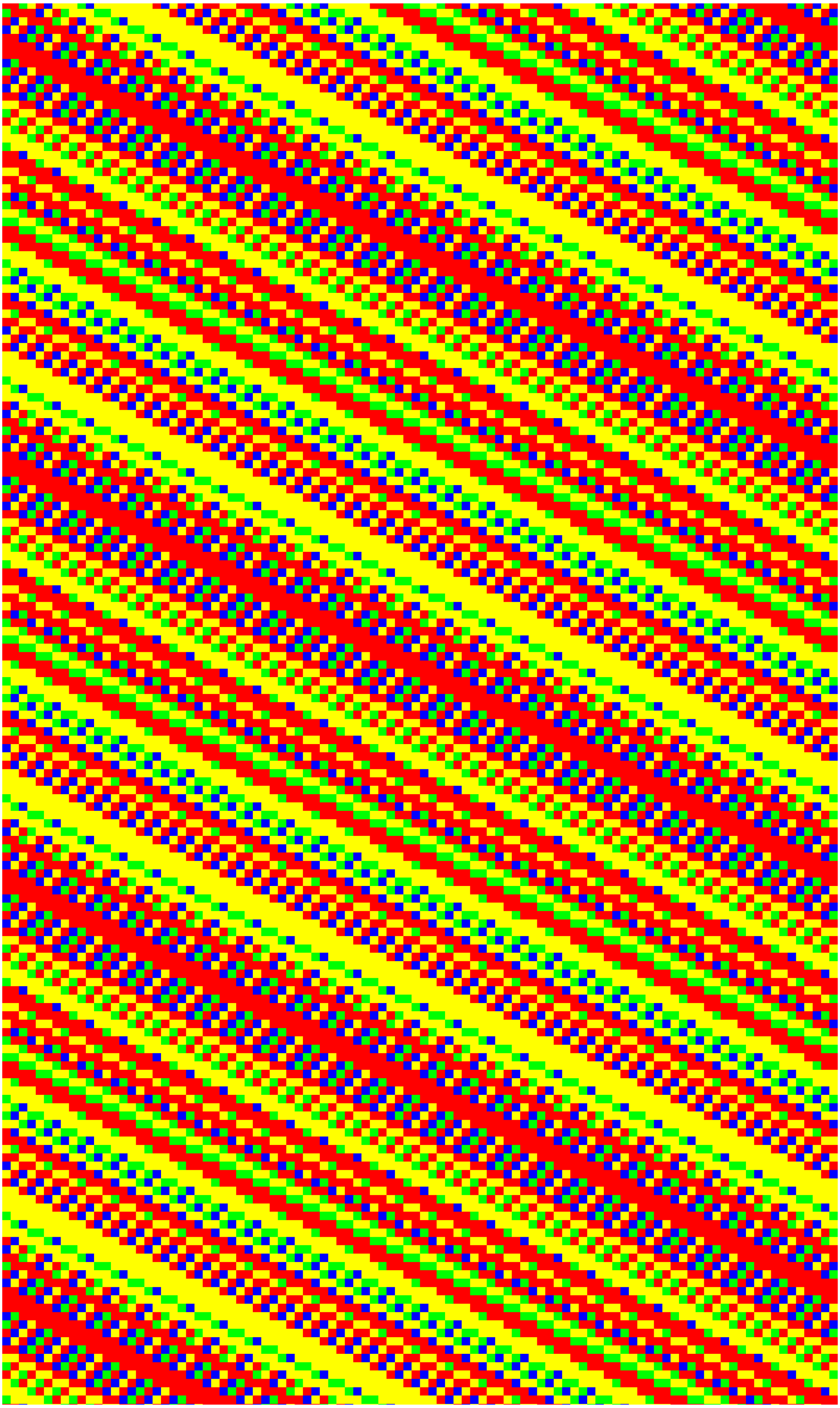


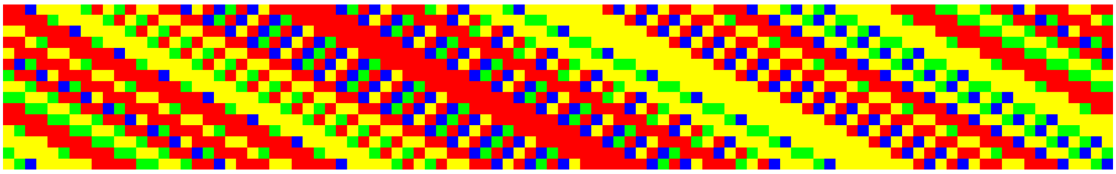


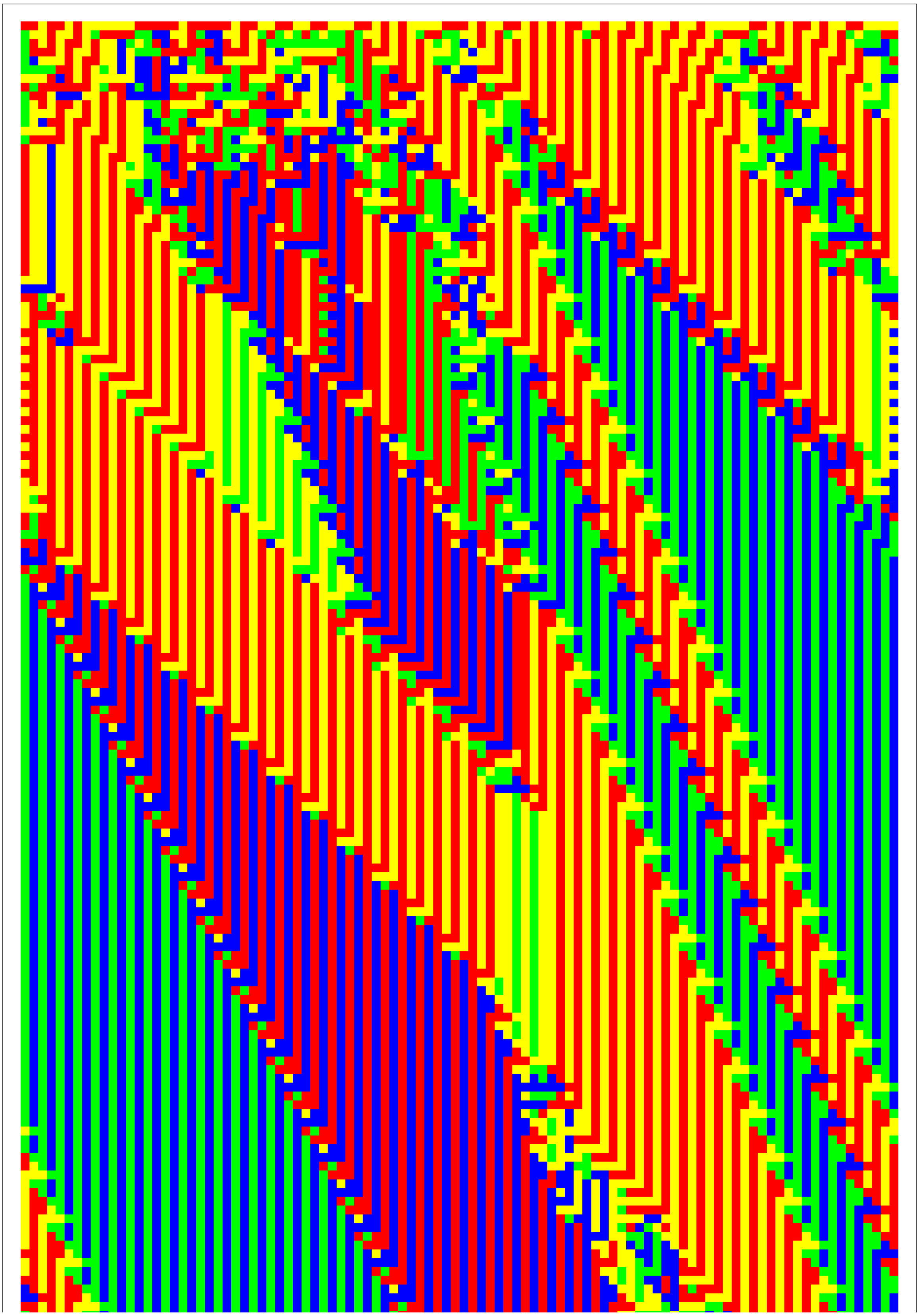


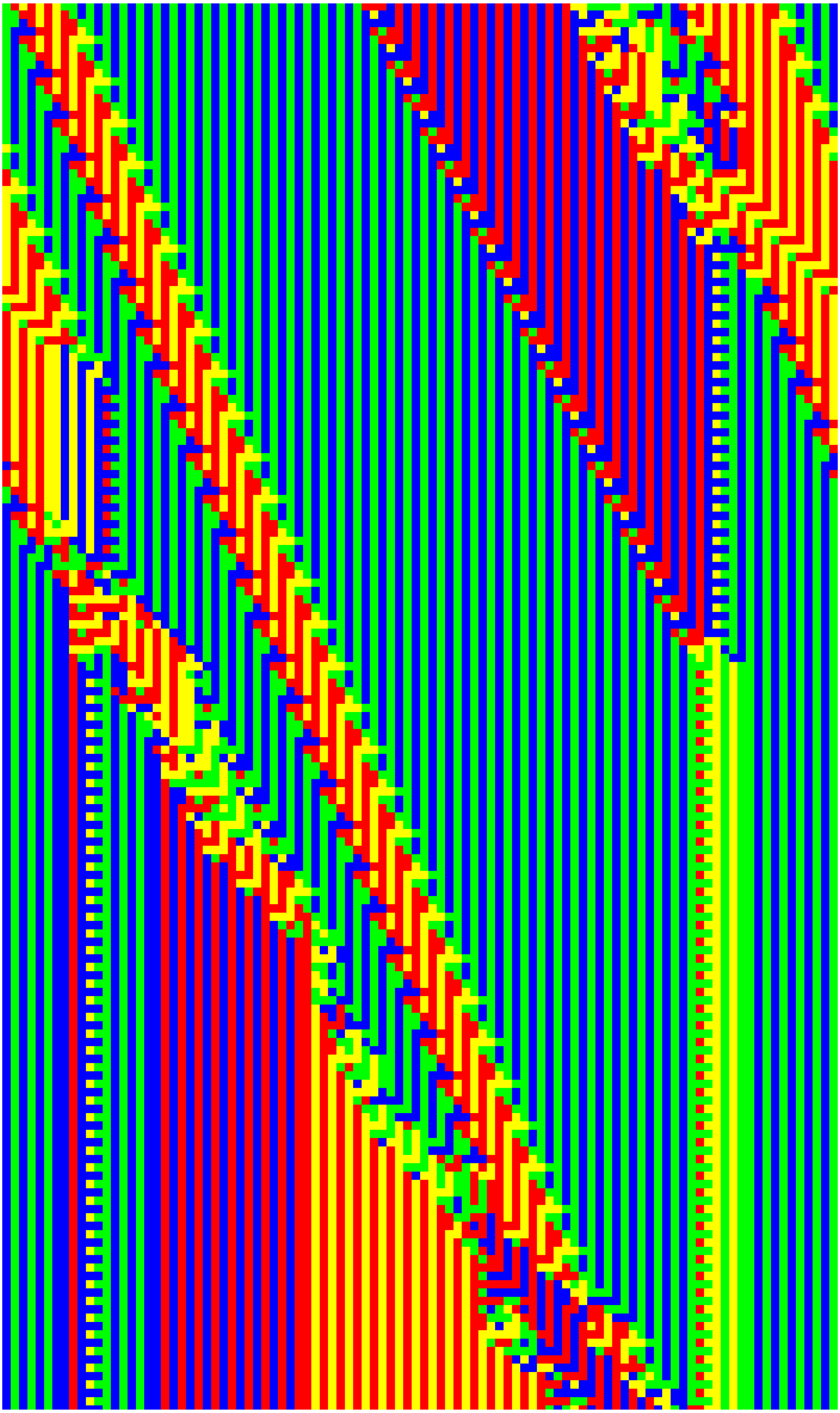


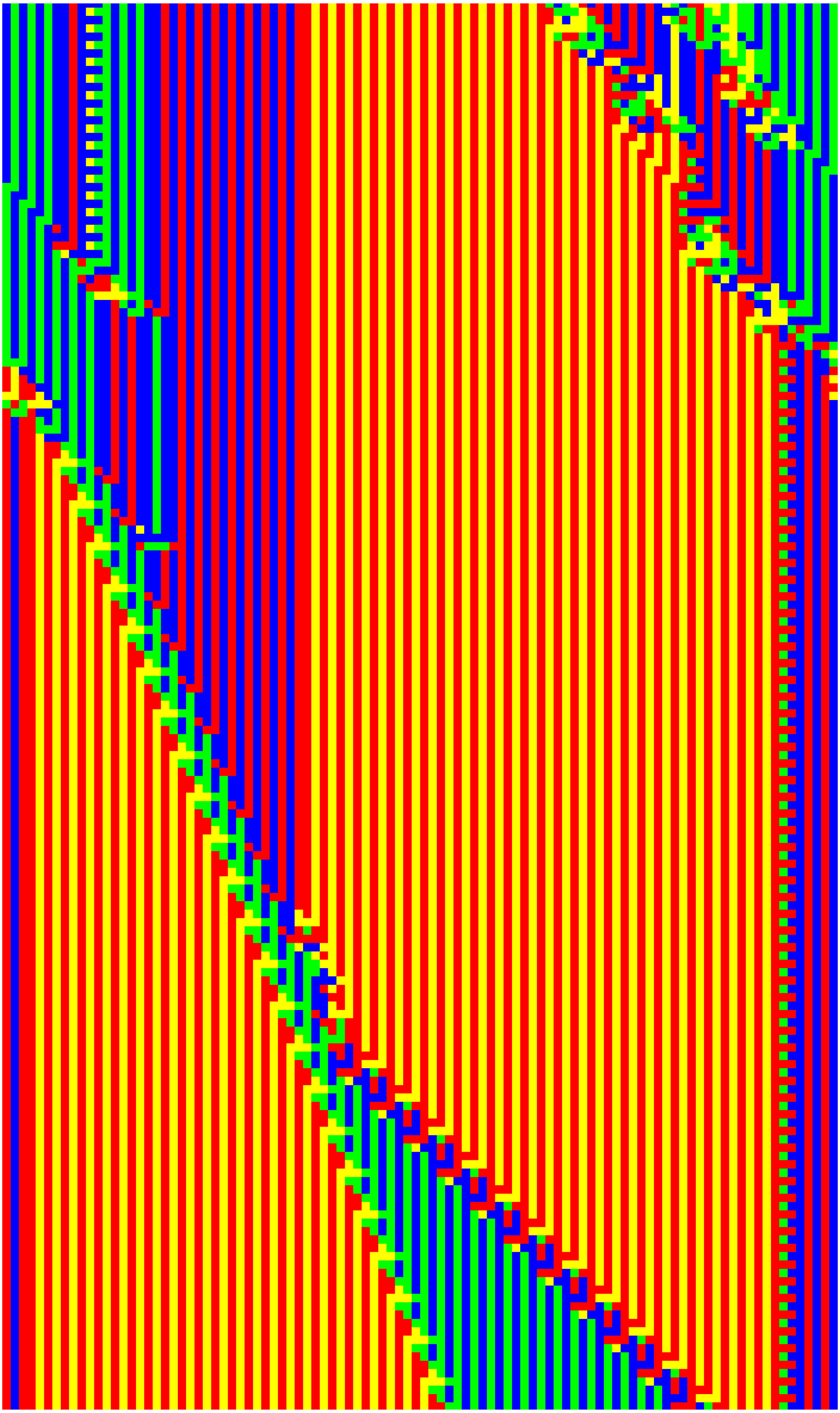


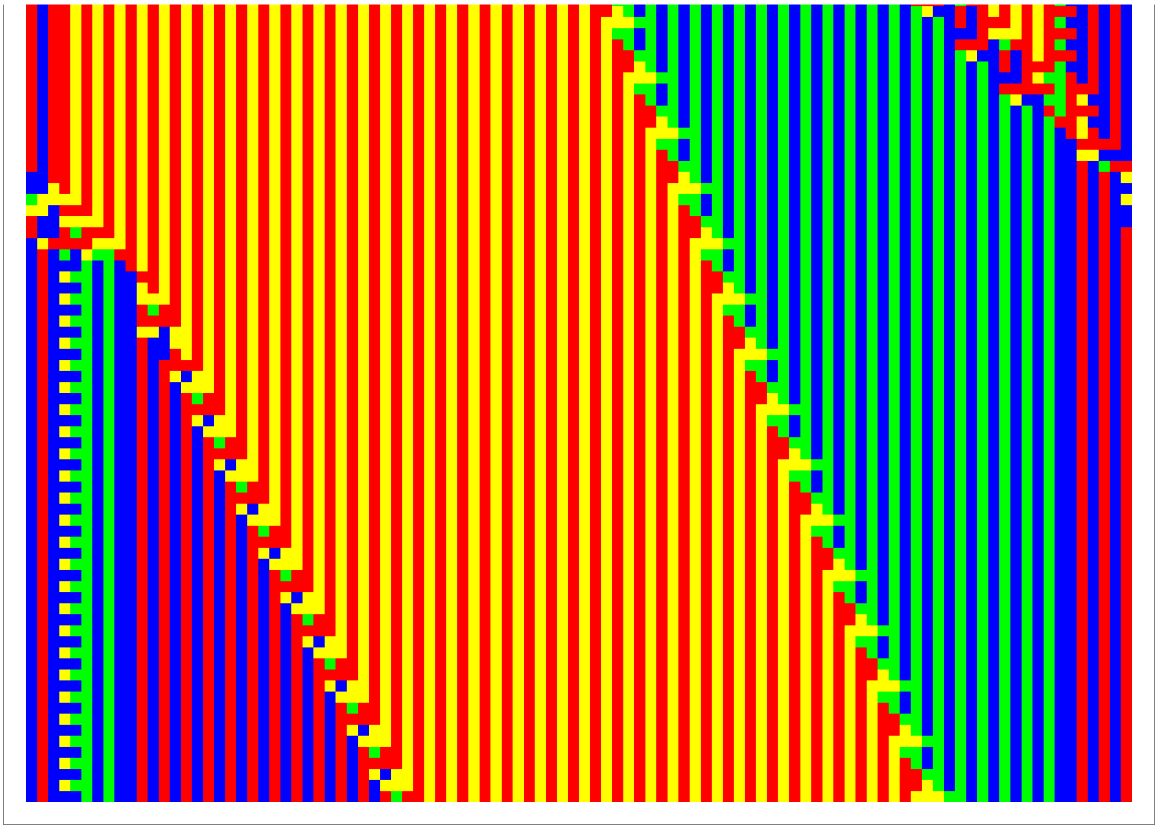


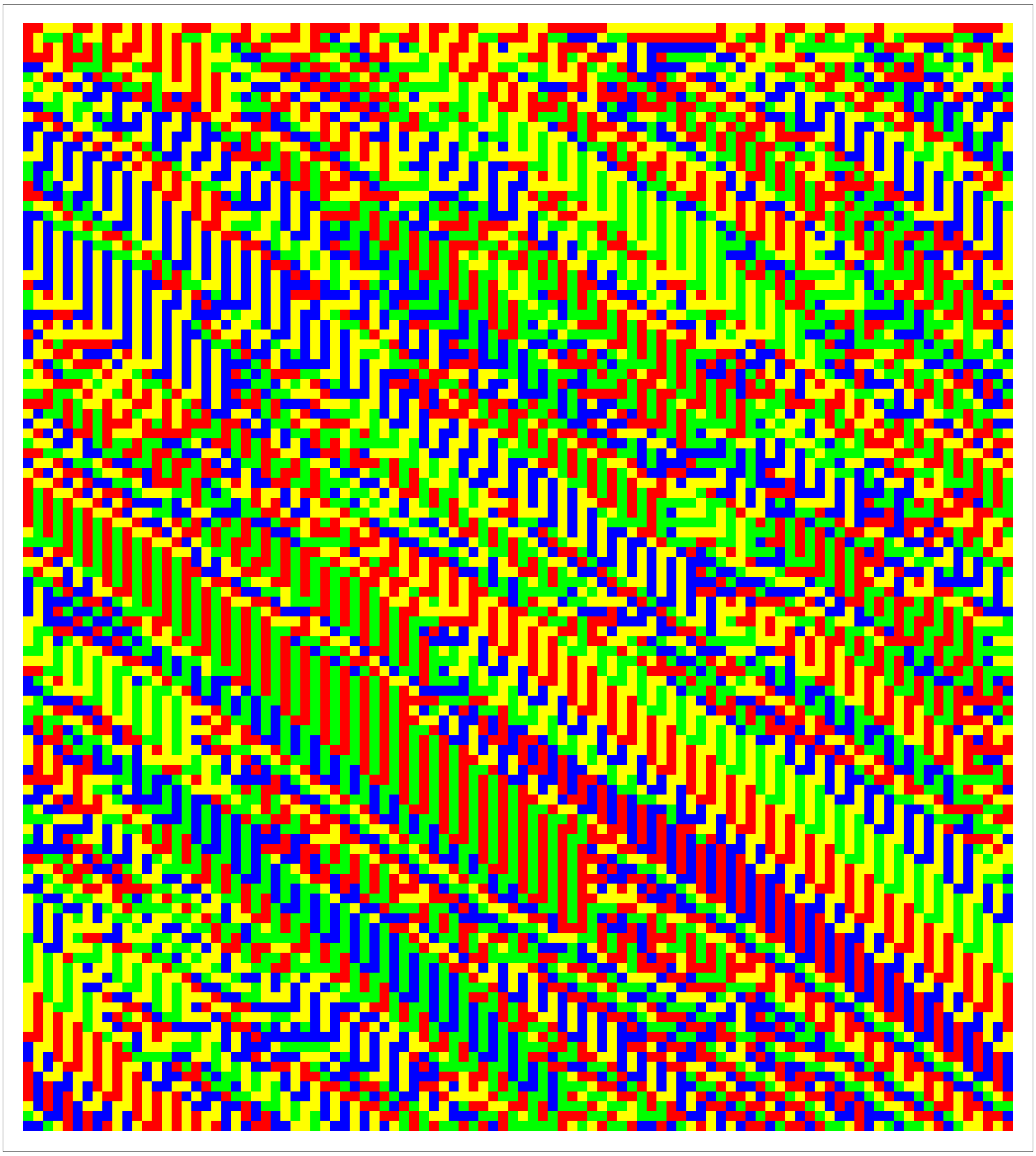


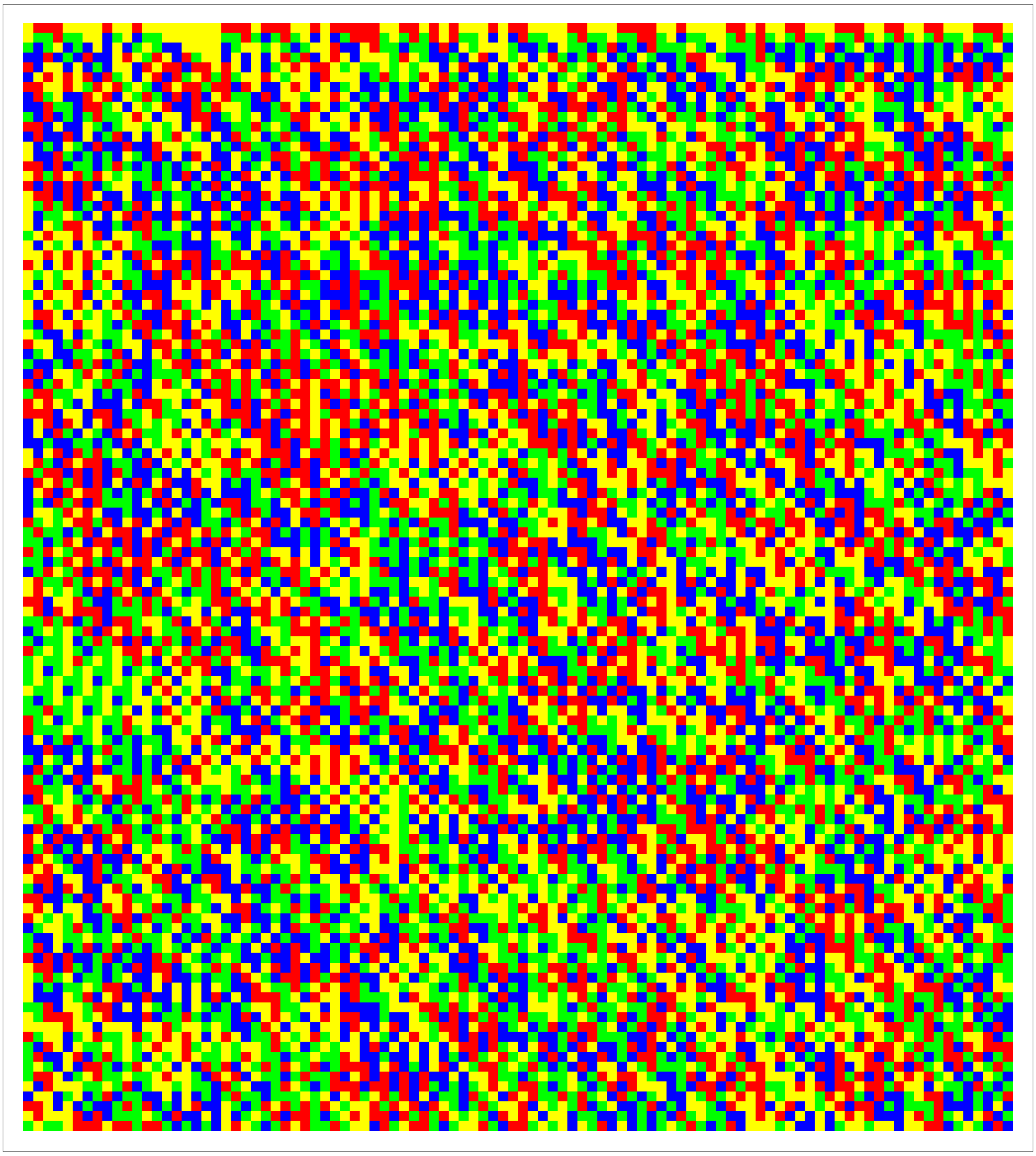


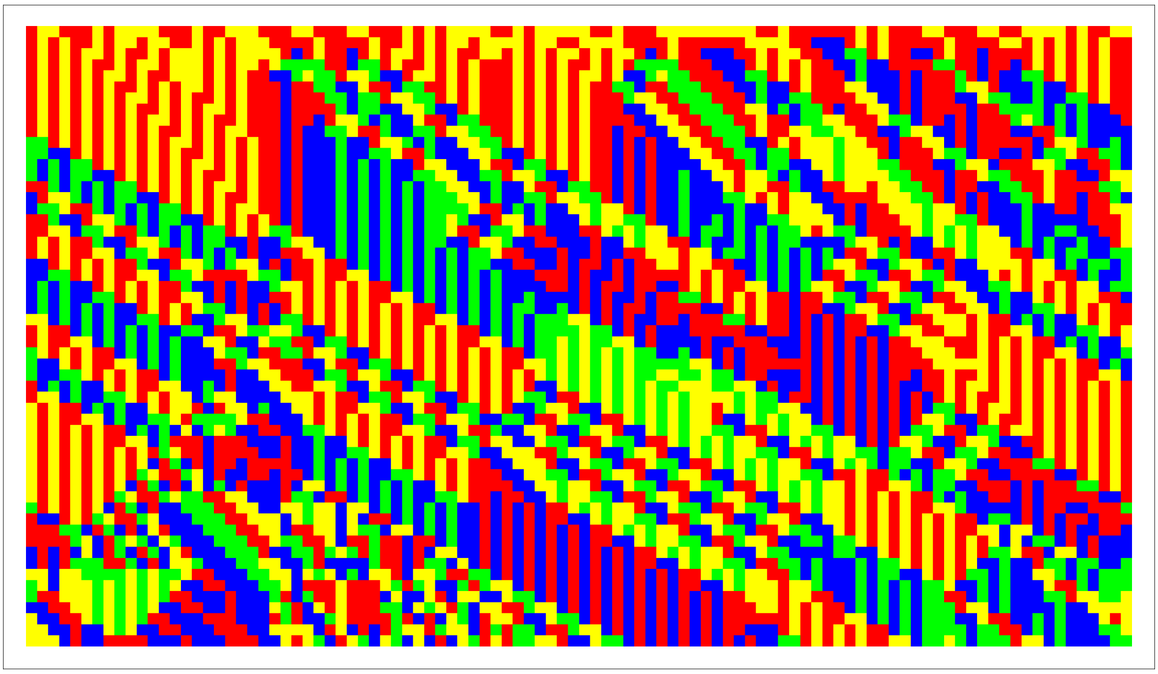


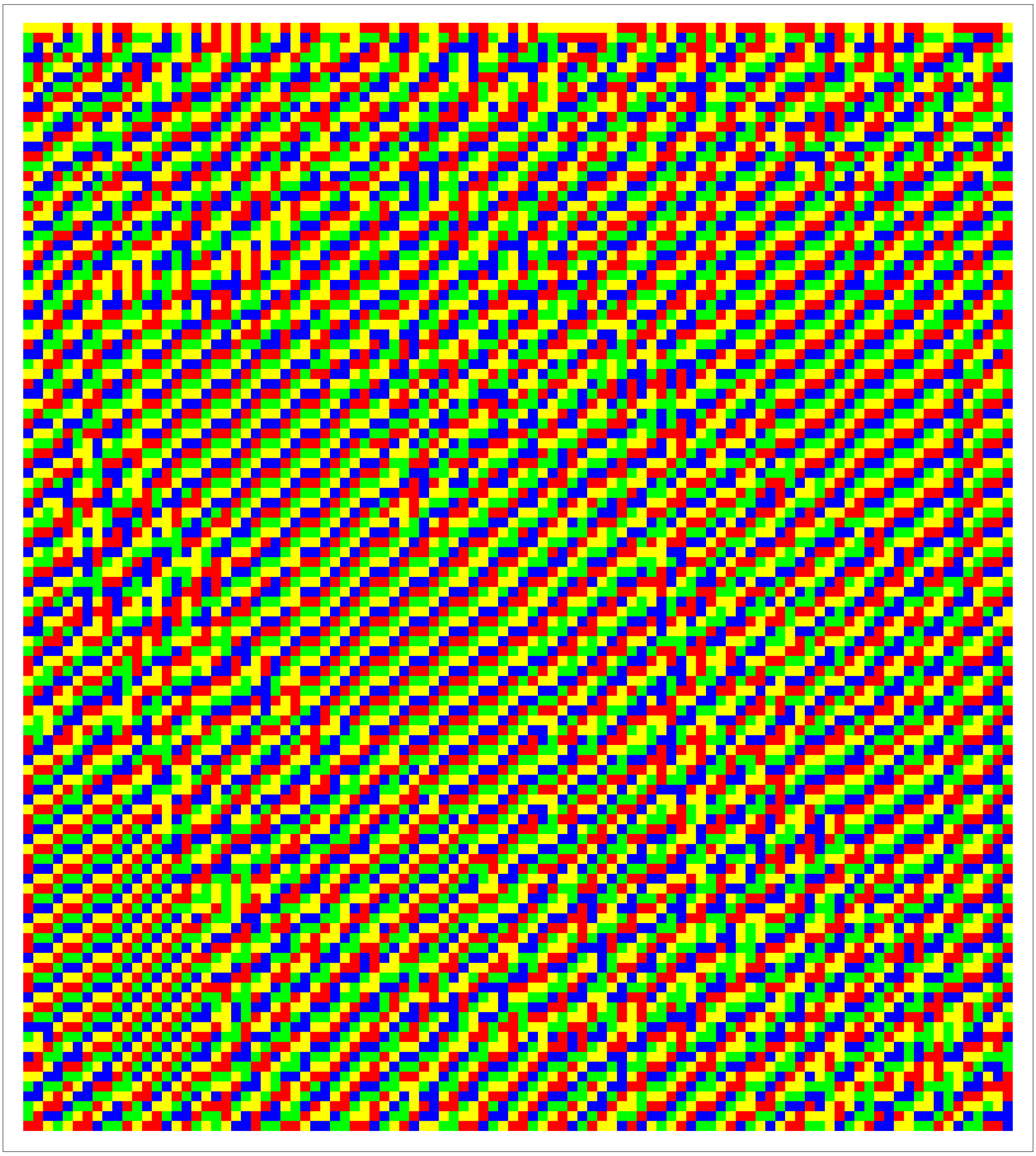












Orientedness: Properties of morphoCA$^{(2,3)}$ as parts of morphoCA$^{(4,2,4)}$

Trivially, despite the content and internal structure of morphoCAs based on the set of the 15 basic morphograms is overwhelmingly asymmetric, their architectonic structure is still symmetric. This holds even more for the classical CAs, like ECAs.

Asymmetric feature are appearing for morphic and classical CAs only ‘externally’ as the *positioning* of the CA’s developments that are internally strictly symmetric.

Because more complex morphoCAs are not based on the symmetrical morphograms, the architectonic structure of this kind of CAs is inherently asymmetric.

This leads to the property of *orientedness* with its distinctions of right-,left- and straight orientedness.

A further distinction appears, the *internal* asymmetry of symmetric morphoCAs might start just after some steps of development while the ‘head’ of the architectonically asymmetric morphoCA is still symmetric.

As a result of this considerations and constructions about the orientedness of morphoCAs it might be stated that classical CAs are inherently architectonically symmetric.

Certainly, the asymmetry of morphoCAs is based on the complexity of the underlying morphograms. For even complex morphograms, symmetry is well supported, while odd complex morphograms are supporting asymmetric morphoCAs.

In the terminology of orientedness it might be said that the concept of ECAs is straight-oriented.

ECAs are not just morphogrammatically incomplete but they are also restricted in their architectonics to symmetric fundaments.

Further informtion at:
http://memristors.memristics.com/ExtendedArchCA/ExtendedArchitecturesCA.html

Exemplification

Interpretations of the applications of morpho-rules of morphoCA$^{(5,2,5)}$ in respect of their orientedness.

RuleSchemeR:

a	b	c	d
–	–	e	–

, **RuleSchemeL:**

a	b	c	d
–	e	–	–

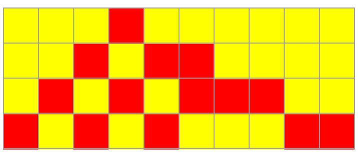
RulesR :

0	0	0	0	0	0	0	0
–	–	0	–	–	–	1	–
0	0	0	1	0	0	0	1
–	–	0	–	–	–	1	–
0	0	1	0	0	0	1	0
–	–	0	–	–	–	1	–
0	1	0	0	0	1	0	0
–	–	0	–	–	–	1	–
0	0	1	1	0	0	1	1
–	–	0	–	–	–	1	–
0	1	0	1	0	1	0	1
–	–	0	–	–	–	1	–
0	1	1	0	0	1	1	0
–	–	0	–	–	–	1	–
0	1	1	1	0	1	1	1
–	–	0	–	–	–	1	–

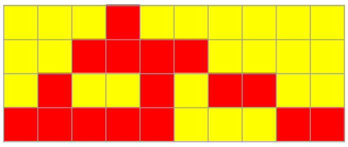
RulesL :

0	0	0	0	0	0	0	0
–	0	–	–	–	1	–	–
0	0	0	1	0	0	0	1
–	0	–	–	–	1	–	–
0	0	1	0	0	0	1	0
–	0	–	–	–	1	–	–
0	1	0	0	0	1	0	0
–	0	–	–	–	1	–	–
0	0	1	1	0	0	1	1
–	0	–	–	–	1	–	–
0	1	0	1	0	1	0	1
–	0	–	–	–	1	–	–
0	1	1	0	0	1	1	0
–	0	–	–	–	1	–	–
0	1	1	1	0	1	1	1
–	0	–	–	–	1	–	–

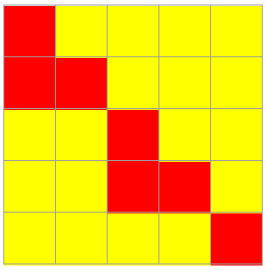
Right: head 1122:R



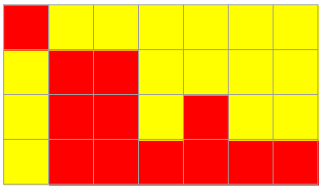
0010 → 0 : R,
0100 → 1 : R,
1000 → 0111 -> 1 : R,
0000 → 0 : R,
0101 → 1 : R,
1011 → 0100 -> 0 : R



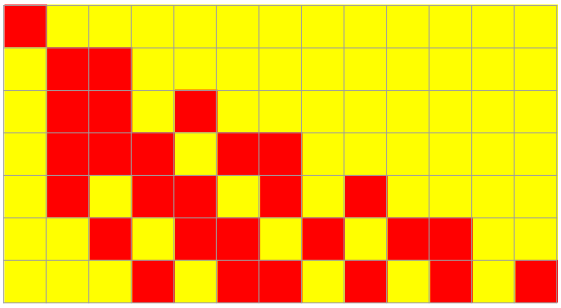
Left: head 1121:L

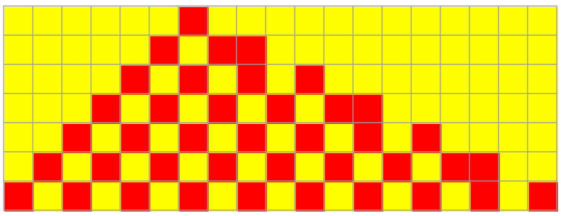


0100 → 1 : L
1000 → 0111 → 1 : L
0000 → 0 : L
1101 → 0010 -> 0 : L

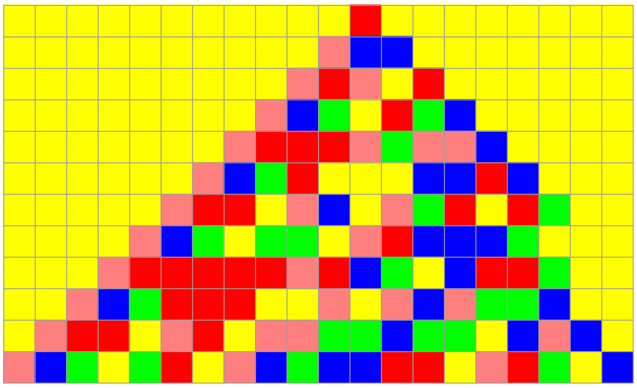


1000 → 1 : L
0000 → 1 : L / 0000 → 0 : R

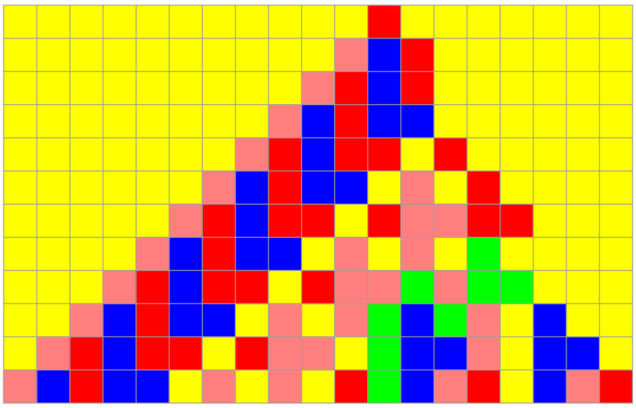


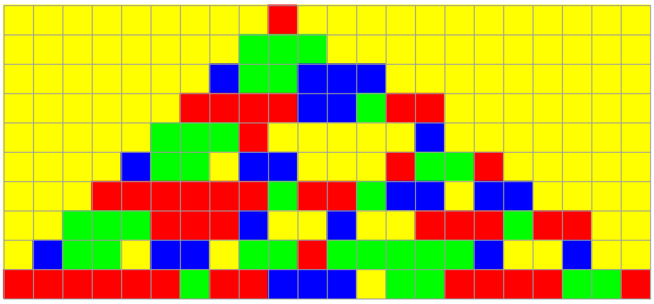


Internal symmetry for the first 6 steps ruled by [2222]

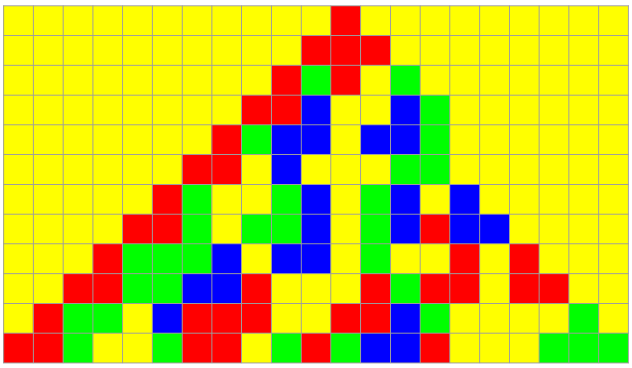


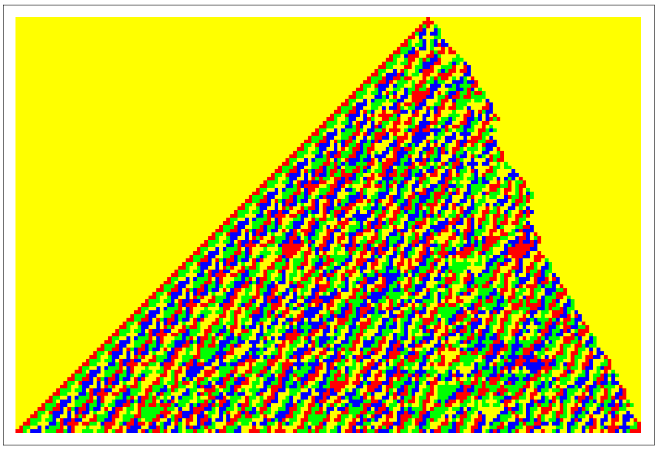
Internal asymmetry after 2 steps



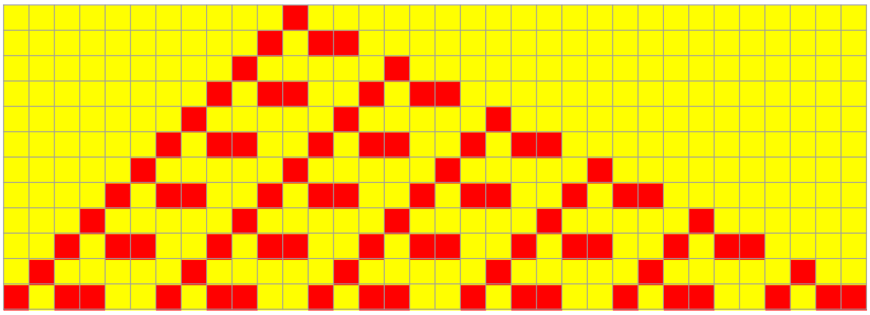


Internal asymmetry after 3 steps

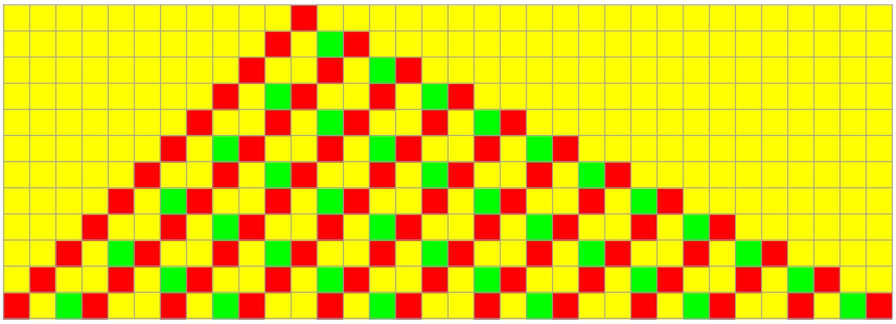




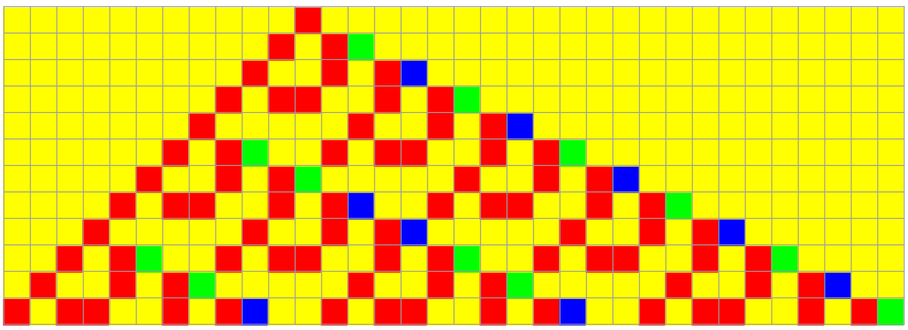
Examples for right - oriented rules



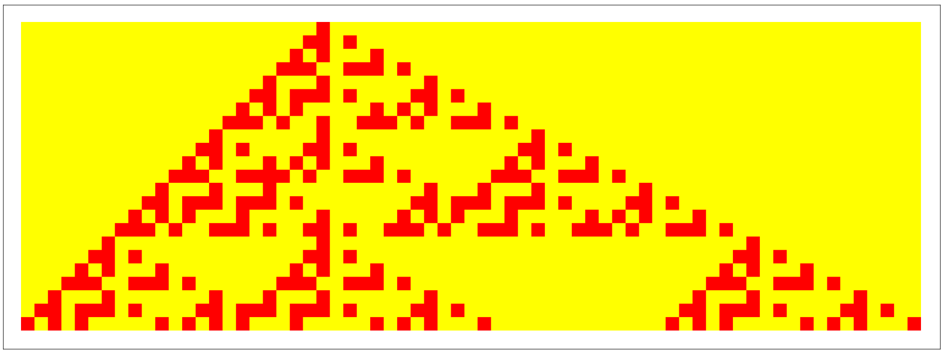
ruleDCKV[{**1111, 1122, 1211, 1222, 2121, 2211, 2221, 2112**}]

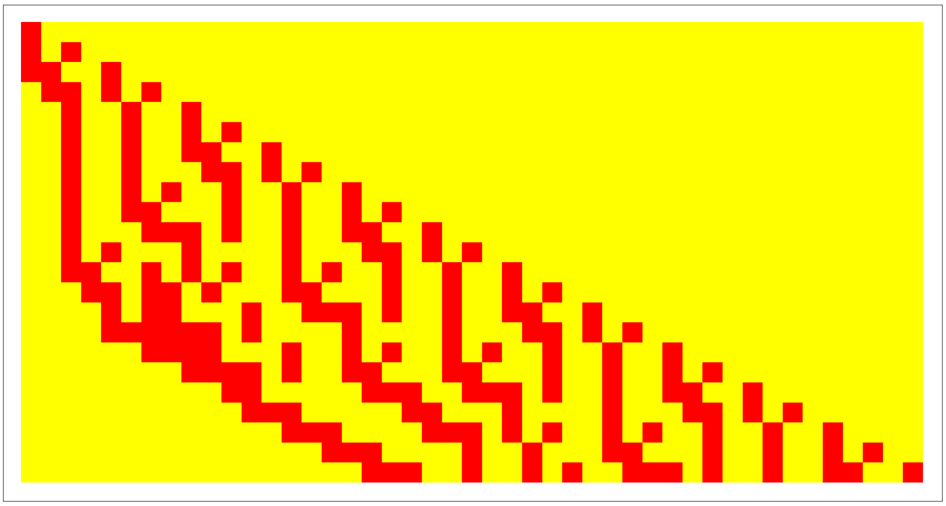


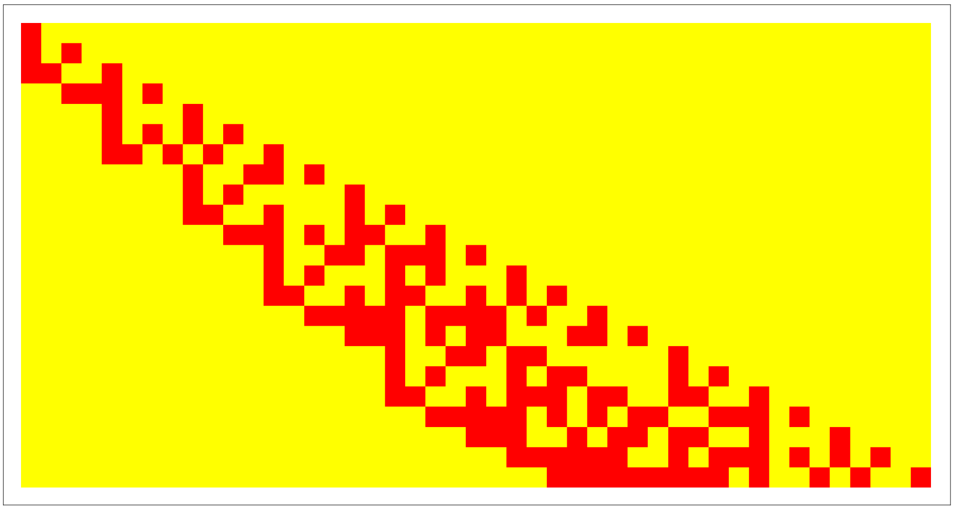
Colored by [2113] : ruleDCKV[{1111, 1122, 1211, 1222, 2121, 2211, 2221, 2113}]

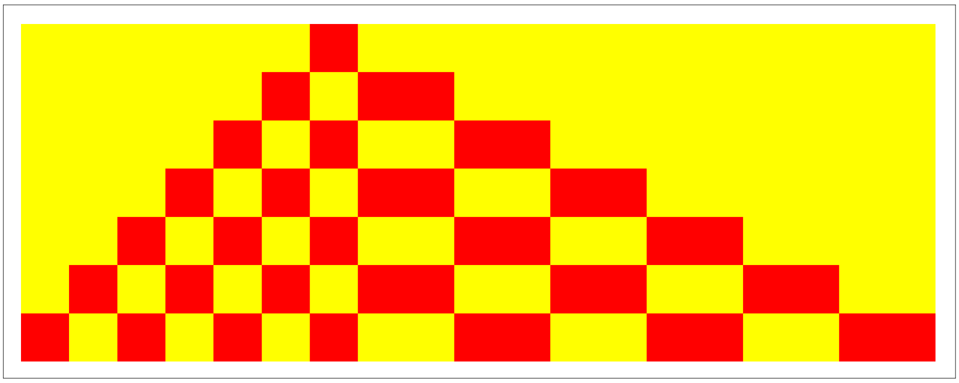


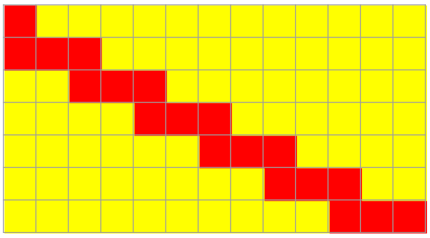
Colored by [2223] : ruleDCKV[{1111, 1122, 1211, 1222, 2121, 2211, 2223, 2112}]



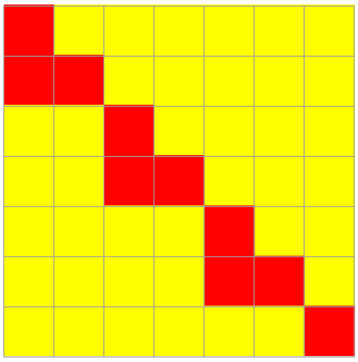






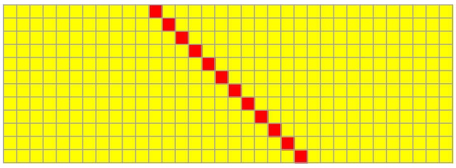


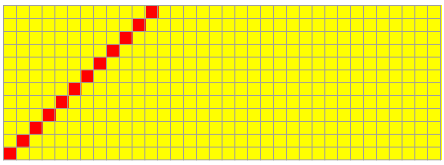
```
ruleDCKV[{1111, 1121, 1212, 1221, 2121, 2211, 2221, 2112, 2112, 2222}]
```



```
ruleDCKV[{1111, 1121, 1122, 1221, 2211, 2212, 1112, 2112, 1212, 2222}]
```

Left - oriented CA





Comparison: Complementarity of right- and left-oriented morphoCA$^{(4,2,4)}$

Right - oriented

Left-oriented CA