

ライフゲーム

総合演習 B

神戸大学

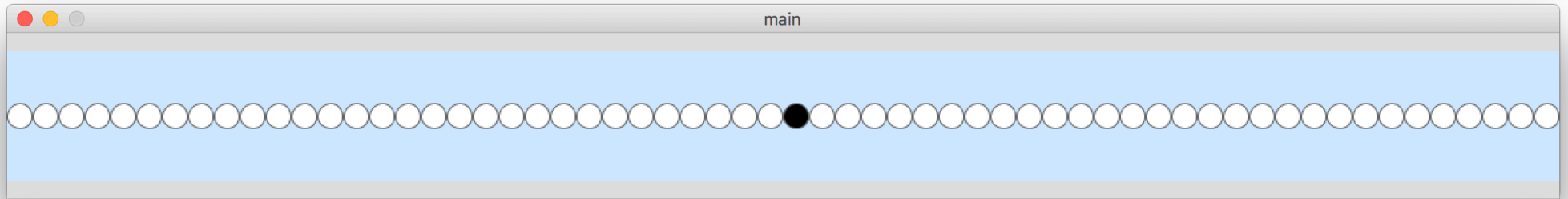
陰山

セル・オートマトン

- ▶ Cellular automata
- ▶ 離散的な空間: 格子状のセル (整数ラベル)
- ▶ 離散的な時間 (整数ラベル)
- ▶ 離散的な物理量: 各セルもつ状態は少数
- ▶ 自分と近傍のセルに依存する状態変化のルール

1次元セルオートマトン

1次元セル・オートマトン



- ▶ 空間1次元
- ▶ 各セルの状態 $s(i)$ は1bit (0か1)
- ▶ ルール $s(i) \Rightarrow s(i) = F(s(i-1), s(i), s(i+1))$

つまり現在時刻の自分と左右両隣のセルの状態で次の時刻の自分の状態が決まる

- ▶ ルールは 2^4 個、つまり16個
 - 自分と両隣の取りうるパターンは 2^3
 - 次の状態が取りうるパターンは2

ウルフラムの"ルール90"

現在の状態			次の状態
左	自分	右	自分
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

(現在の左 + 現在の右) の値が・・・

偶数 \Rightarrow 次は 0

奇数 \Rightarrow 次は 1

ウルフラムの"ルール90"

参考: <http://mathworld.wolfram.com/Rule90.html>

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Built with Mathematica Technology

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Rule 90

DOWNLOAD
Wolfram Notebook

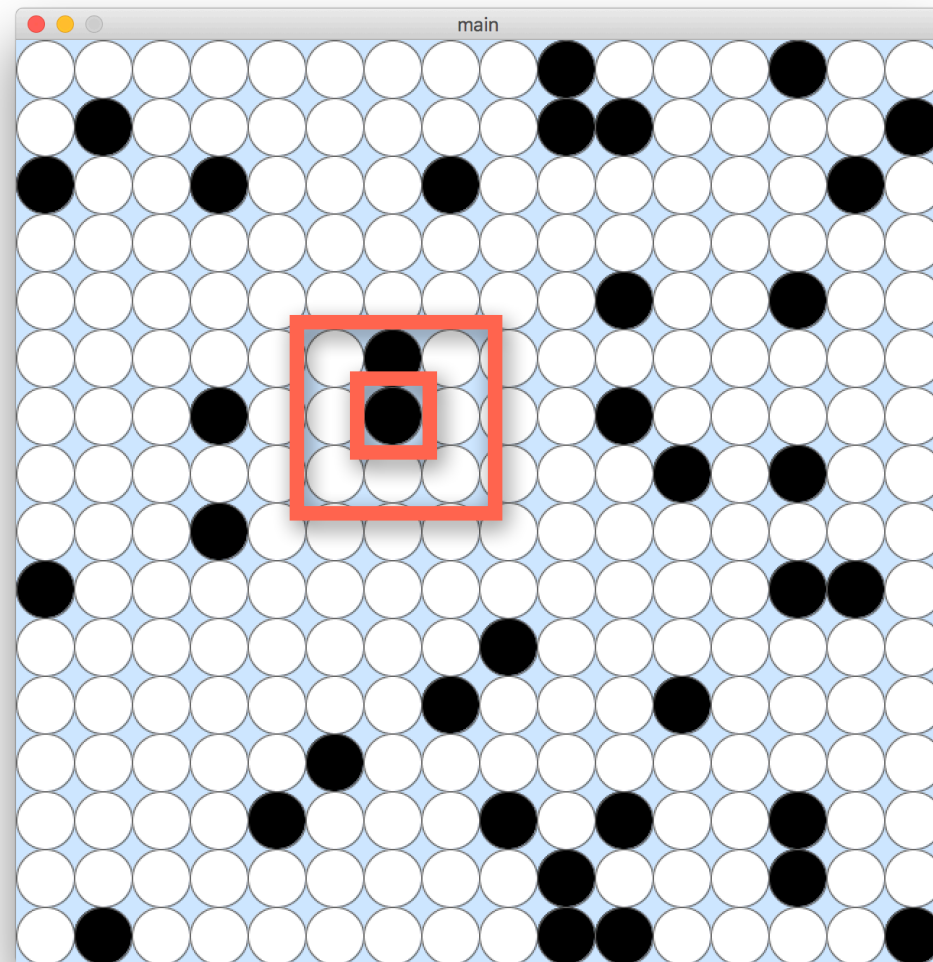
rule 90

The diagram illustrates the Rule 90 cellular automaton. At the top, the title "rule 90" is displayed. Below it, a row of eight cells is shown, each containing a 2x2 grid of black and white squares. These cells are labeled with the values 0, 1, 0, 1, 1, 0, 1, 0 from left to right. Below this row is a large grid showing the evolution of the automaton over time. The grid is 20 columns wide and 10 rows high. The pattern of black and white squares forms a symmetric, fractal-like structure that expands outwards from the center.

2次元セルオートマトン

2次元セルオートマトン

- ▶ 自分と周囲の8個の状態から次の状態が決まる
- ▶ 可能なルールは $2^{10}=1024$ 通り



ライフゲーム (Game of Life)

- ▶ 1970年、数学者ジョン・コンウェイ (1937-) が考案



Photo by Thane Plambeck

<https://www.flickr.com/photos/thane/20366806/>

ライフゲームのルール

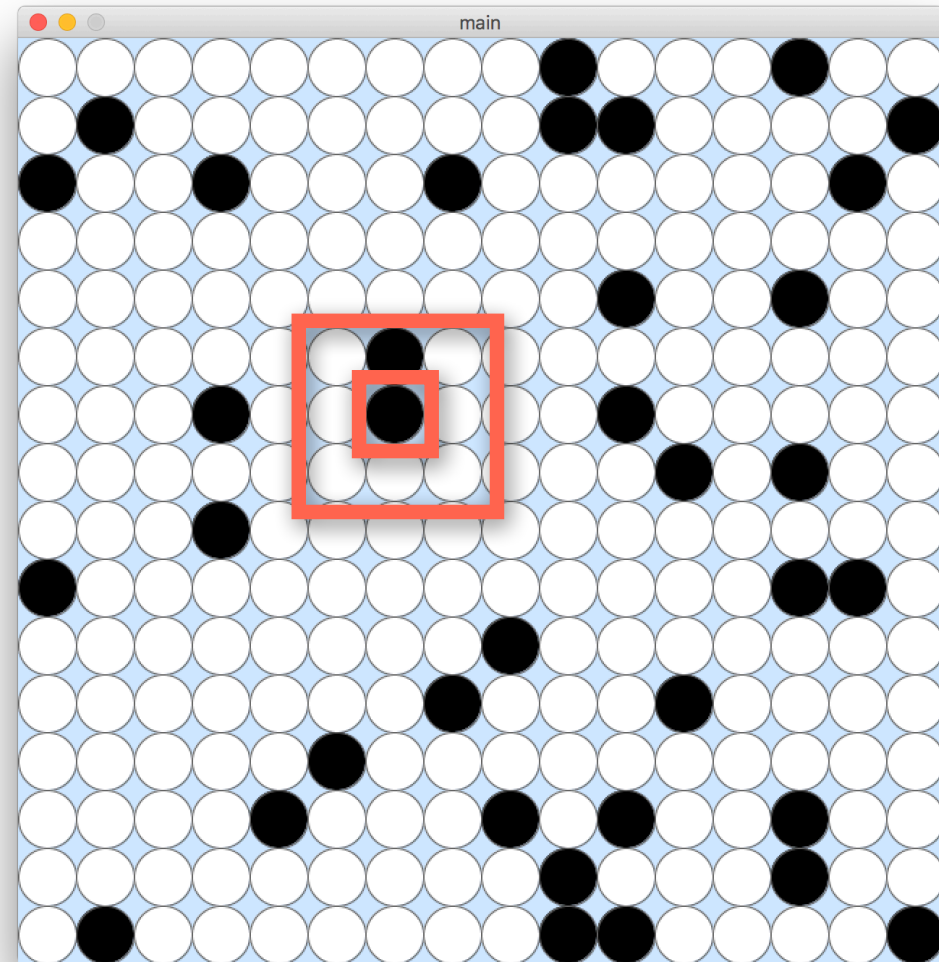
▶ 自分の値を変更するのは・・・（これ以外は変更なし）

– 自分が0の場合：

周囲にある1の数が3のとき
⇒自分を1にする（誕生）

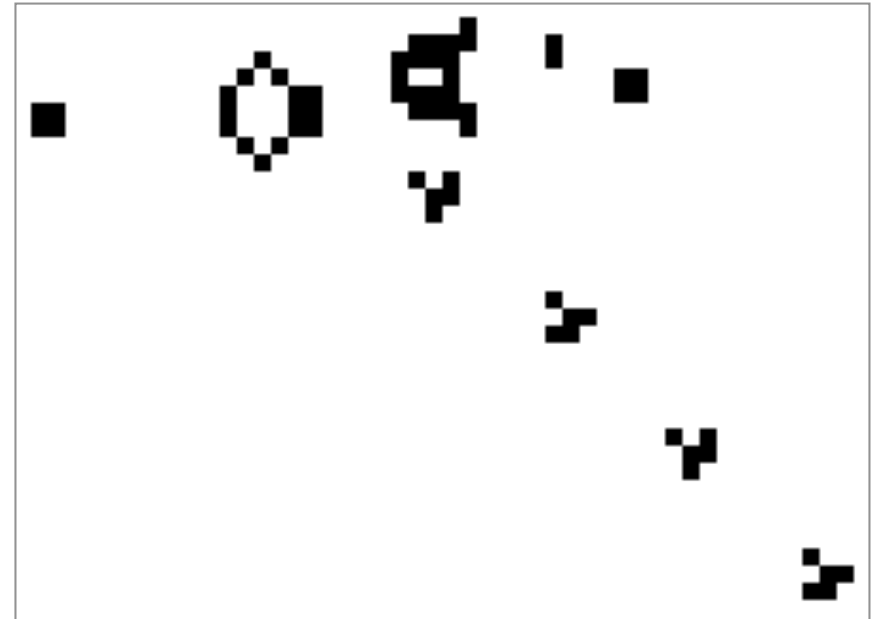
– 自分が1の場合：

周囲にある1の数が1以下か4
以上のとき
⇒自分を0にする（死亡）



様々なパターン（生命）


- ▶ 初期条件を変えて探索
- ▶ ゴスパーのグライダー銃
- ▶ 「グライダー」を次々と発射



author: Kieff

LifeWiki

http://www.conwaylife.com/wiki/Main_Page



Tetromino - Wikipedia

navigation

- Wiki home
- ConwayLife.com
- How to contribute
- Tiki bar
- Recent changes
- Random page
- Links

search

Search

Go Search

tools

- What links here
- Related changes
- Special pages
- Printable version
- Permanent link
- Page information

create account

log in

page

discussion

view source

history

Overview · How to contribute · ConwayLife.com

Welcome to LifeWiki,

the wiki for Conway's Game of Life.

Currently contains **1,864** articles.

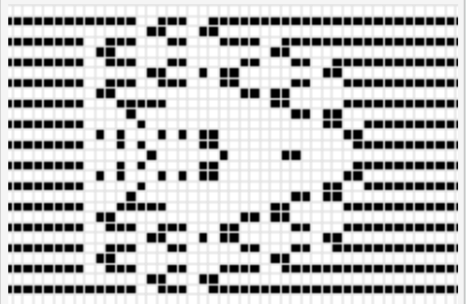
- Guns
- Methuselahs
- Oscillators
- Puffers
- Spaceships
- Still lifes
- Wicks
- All patterns
- Everything else

Image gallery · Popular pages · A–Z index

This week's featured article

A **negative spaceship** is a type of **signal** traveling through a periodic **agar** such as **zebra stripes**. The leading edge of the signal removes the agar, and the trailing edge rebuilds the agar some time later. The distance between the two edges is sometimes adjustable, as shown in **lightspeed bubble**. The central part of the "spaceship" may consist of dying **sparks** or even simple **empty space**.

[Read more...](#)



(click above to open LifeViewer)

In the news

- Dave Greene** completes the construction of a stable **line crosser** with a **repeat time** of 501 ticks.
- The **Minstrels**, a group of **tagalongs** for **Sir Robin**, are discovered.

Did you know...

- ... that the **blinker** is the only known **oscillator** that is **one cell thick**?
- ... that the first **spaceship** found in **Conway's Game of Life** that travels in an **oblique direction** was discovered in **2010**?
- ... that there are **still lifes** that can be split into four stable **islands**, but not two or three?
- ... that no new **spaceship speeds** were discovered after **1970** until **1989**?
- ... that the first stable reflector was found in October 1996, and the **first fast stable reflector** appeared in 2013, allowing the construction of oscillators of all periods ≥ 43 ticks?
- ... that twenty-four **spaceship** velocities have been constructed, including five infinitely adjustable families of ships?

12

ライフゲーム

▶ 書籍

『ライフゲームの宇宙』

▶ Web page

http://www.conwaylife.com/wiki/Main_Page

