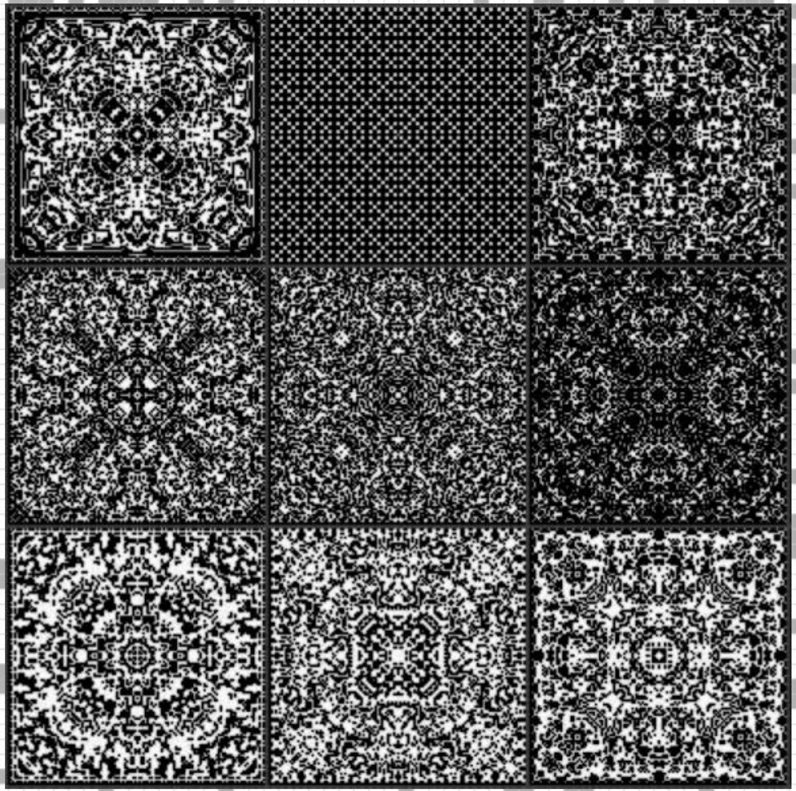
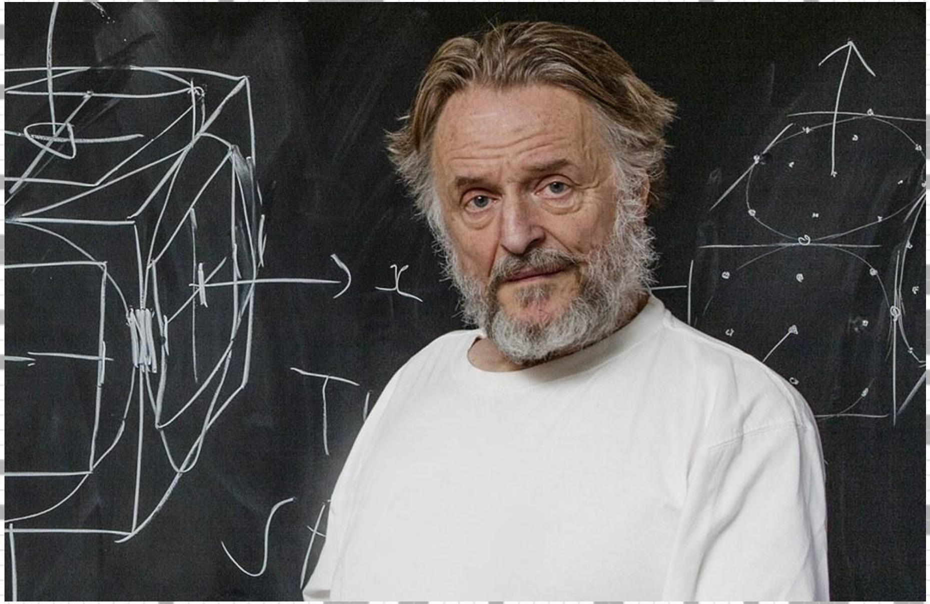
Game of Life



XJ Xu

John Horton Conway, FRS



1937-

- British mathematician at Princeton
- Claims to have never worked a day in his life and spends his time playing.
- Martini Gardner popularized the game "Life" in a Oct 1970 issue of Scientific American.

https://www.scientificamerican.com/magazine/sa/1970/10-01/#article-mathematical-games-1970-10
https://www.wired.com/2015/09/life-games-playful-genius-john-conway/

Life Rules

Let n be the number of alive neighbours

BIRTH RULE

If n == 3, then cell.born()

DEATH RULE:

If n < 2 or n > 3, then cell.die()

SURVIVAL RULE:

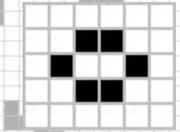
If n == 2 or n == 3, then cell.survive()

http://web.stanford.edu/~cdebs/GameOfLife/

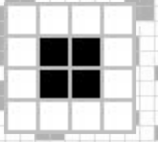
Simpler kinds of life characterization

Static bois

Beehive

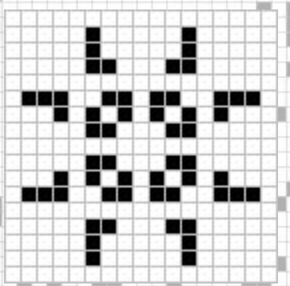


Block

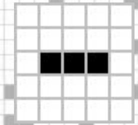


Undecided bois

Pulsar

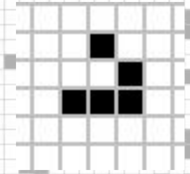


Blinker

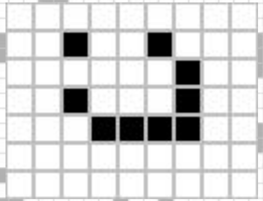


Dyno bois

Glider

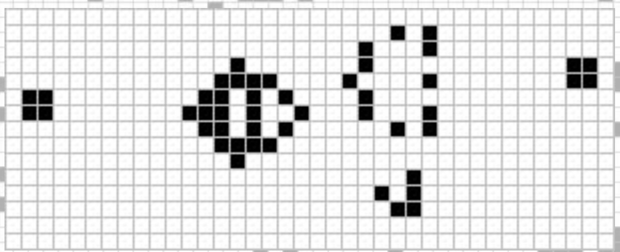


Lightweight spaceship



Reproductive bois

Glider gun



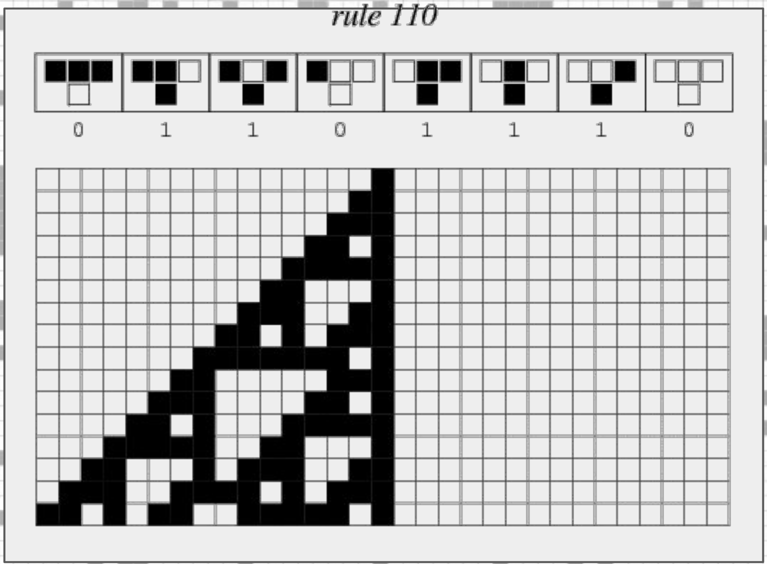
Crazier kinds of life

Ultra reproductive bois

Glider breeders

Glider gun
breeders

Stephen Wolfram

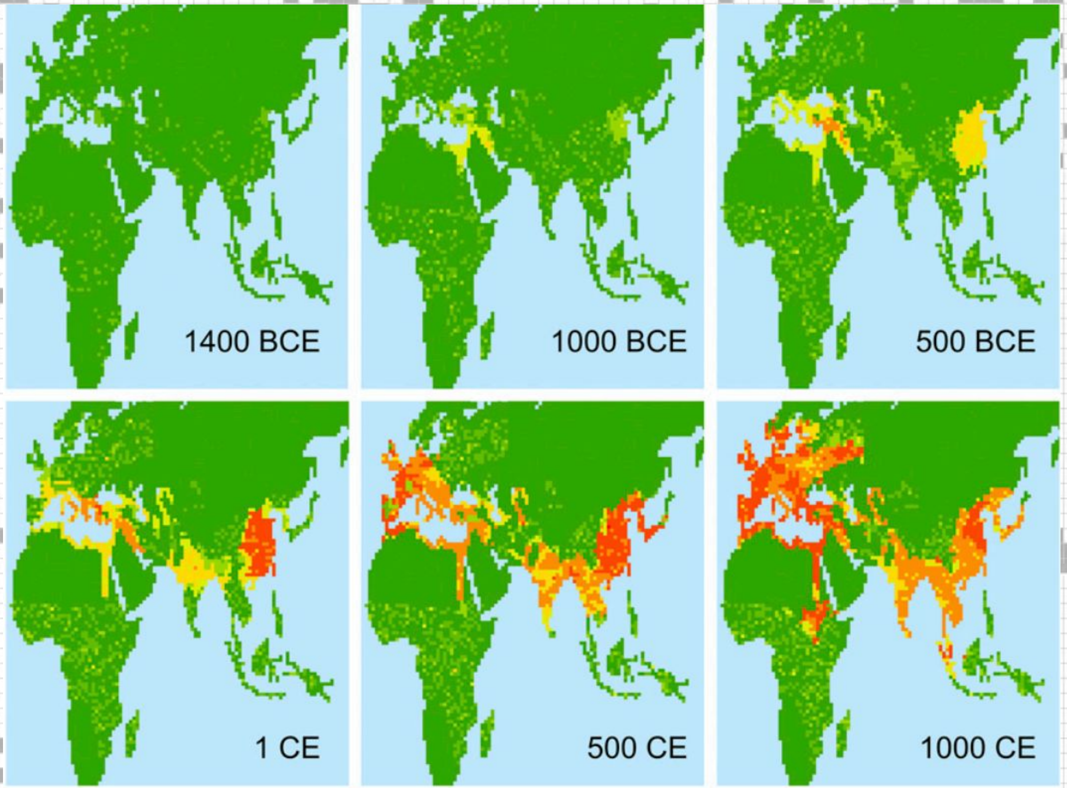


- 1959-
- PhD in particle physics at age 20.
- Wolfram began working independently in the 1980s, generalizing cellular automata -> 1-dimensional elementary cellular automata.[2]
- Turing complete Rule 110 cellular automata[3]

[1] http://mathworld.wolfram.com/Rule110.html
[2] Stephen Wolfram (2002) *A New Kind of Science*
[3] Cook, Matthew (2004). "Universality in Elementary Cellular Automata". *Complex Systems*. **15** (1). ISSN 0891-2513.

Simulate the world

- With more complex rules, this model produced a 65% match with actual history



Turchin et al. (2013) www.pnas.org/cgi/doi/10.1073/pnas.1308825110
http://blog.longnow.org/02013/10/08/conways-game-of-life-and-three-millennia-of-human-history/

Excitable medium

Examples: a forest on fire or a piece of heart tissue

- If a cell is **quiescent**, then it remains quiescent unless one or more of its neighbours is excited.
- If a cell is **excited**, it becomes refractory at the next iteration.
- If a cell is **refractory**, then its remaining refractory period is lessened at the next period, until it reaches the end of the refractory period and becomes excitable once more.

J. M. Greenberg; S. P. Hastings (1978). "Spatial Patterns for Discrete Models of Diffusion in Excitable Media". *SIAM Journal of Applied Mathematics*. 54 (3): 515–523. doi:10.1137/0134040.
Khan MS, Yousuf S. 2016 Mar;29(2):579-84. A cardiac electrical activity model based on a cellular automata system in comparison with neural network model. Pak J Pharm Sci.