

# Time-like and Space-like Paths in 1-D Cellular Automata

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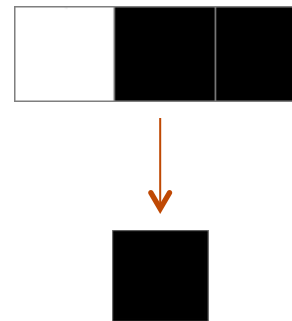
# Review of 1-D Cellular Automata

- 2-D: adds spacial separation to time sequence



- Different rules for progressing to next time step dependent on neighbors

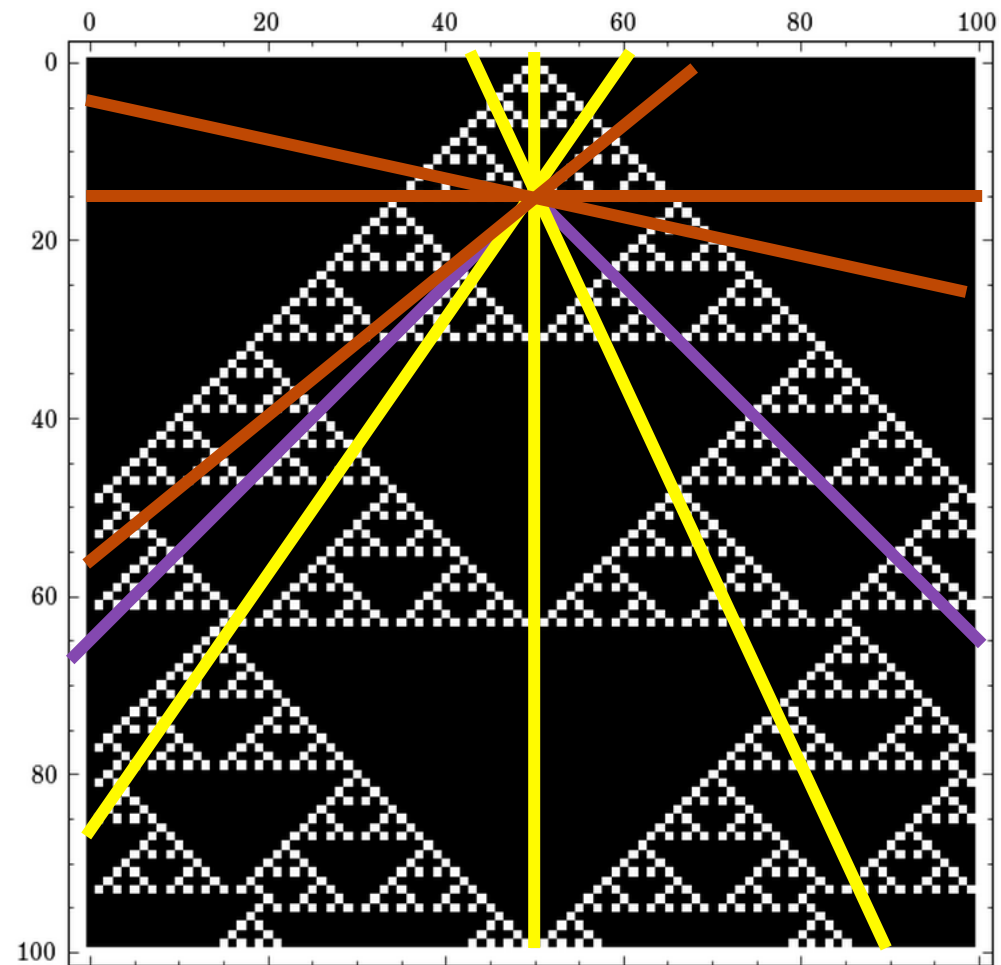
- i.e.



- The spacial extent of influence gives “speed of light”

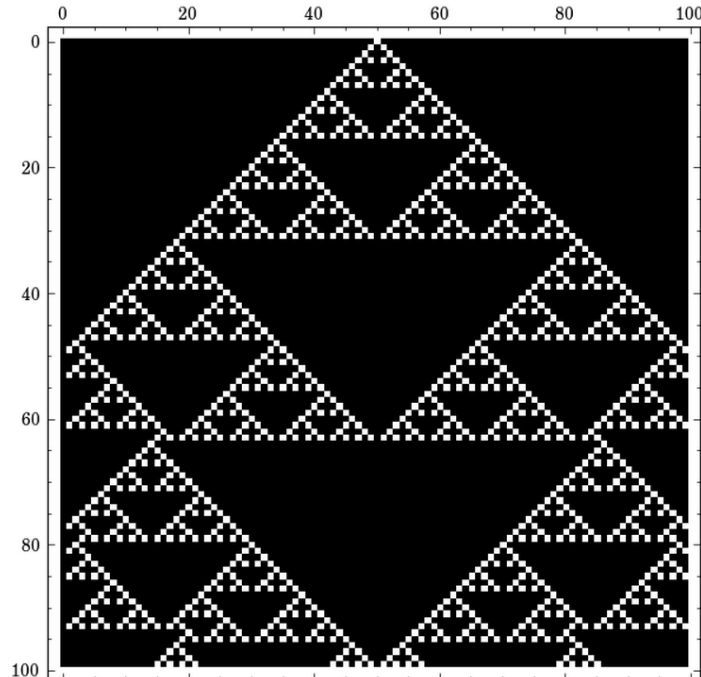
?

- Can collect 1-D sequences in different ways:



# Motivation

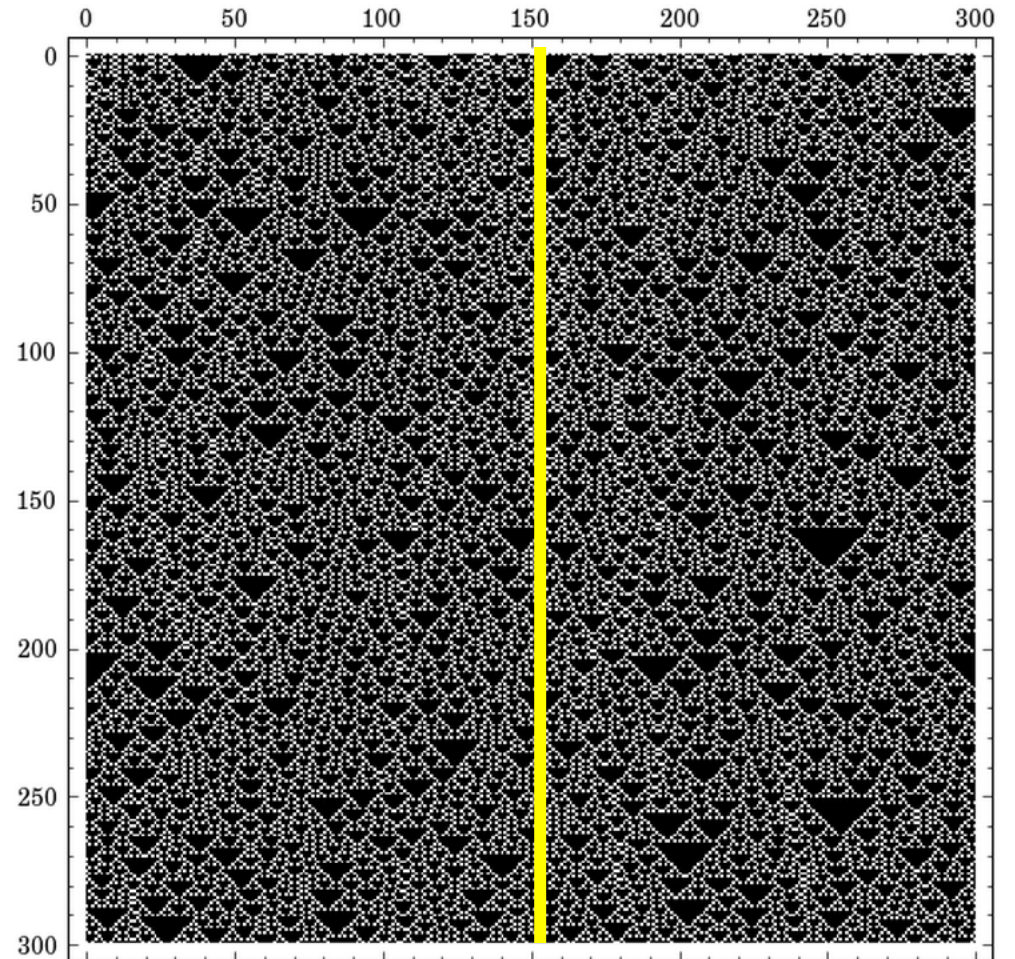
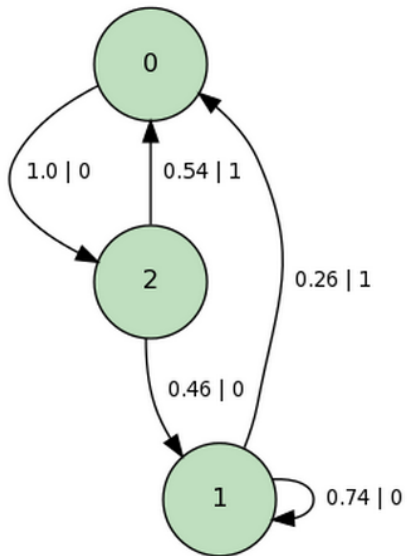
- Cellular Automata are cool!
- Our universe has these properties
  - $3+1$  as opposed to  $1+1$
- Will causal structure reveal itself in 1-D sequences?



# Example: Rule 18

- Time-like:  $v = 0$

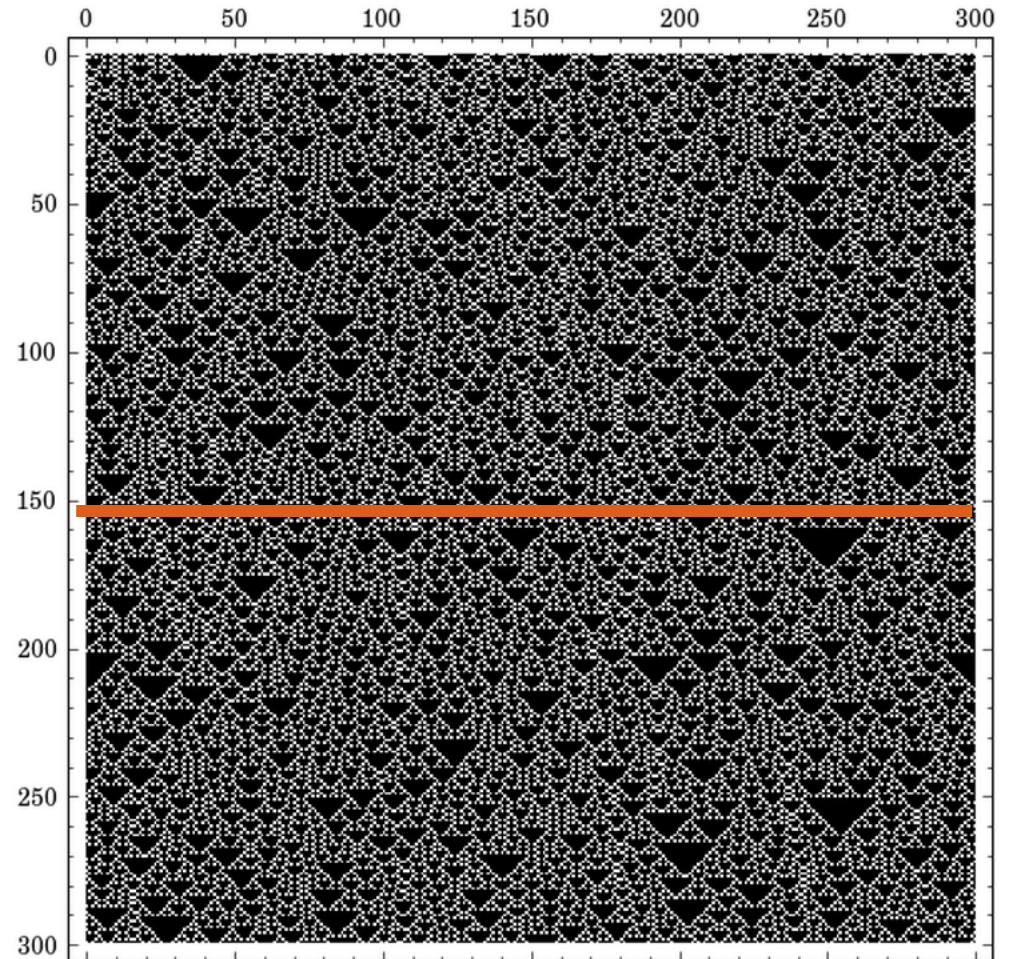
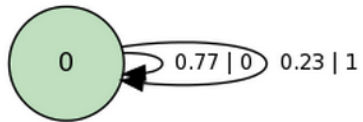
	$h\mu$	$C\mu$	$E$
Inferred Machine	0.65236	1.53235	0.22763



# Example: Rule 18

- Space-like:  $v = \infty$

	$h\mu$	$C\mu$	E
Inferred Machine	0.77216	0.00000	0.00000



# Velocity = 0

Starting cell	$h\mu$	$C\mu$	E
0	0.63367	1.52304	0.25570
40	0.65385	0.73034	0.07648
130	0.66354	1.50653	0.17946
240	0.66065	1.52099	0.19970

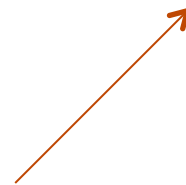
# Velocity = 0.5

Starting cell	$h\mu$	$C\mu$	E
0	0.80163	0.00000	0.00000
40	0.80163	0.00000	0.00000
130	0.80809	0.00000	0.00000
240	0.78148	0.00000	0.00000



Velocity =  $\infty$

Time	$h\mu$	$C\mu$	E
10	0.84432	0.00000	0.00000
40	0.79504	0.00000	0.00000
130	0.64822	1.53974	0.24329
240	0.78600	3.15726	0.01765



27 states!

## So far...

- Not totally sure!
- Naively, there seems to be slight differences in the appearance of 1, 2, 3 (, 27) state machines for different velocities
- Need more stats
  - Rewriting to use Bayesian inference, automate
  - Of interest: some velocities seem to return dangling state errors more than others

## Continuing work:

- Compare different Elementary CA rules
- Look at “non-Elementary” CAs
- Does causal-sensitivity of information measures depend on speed of light?

Thanks