

Artificial Life Theory

Professor Sara Imari Walker



Fixed Law of Motion f

PHYSICS:

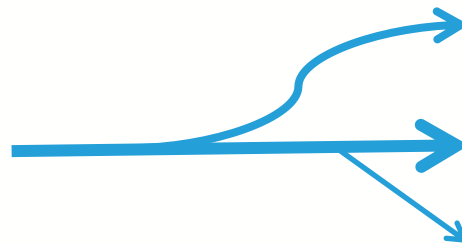
Initial State
 S_i



Final State
 S_f

BIOLOGY:

Initial State
 S_i

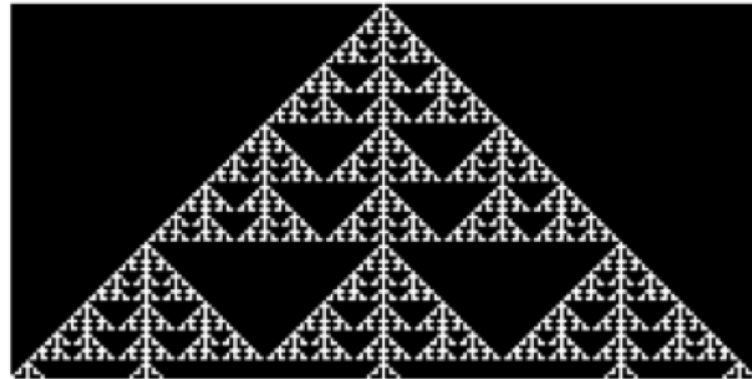


S'_f
 S''_f Final
 S'''_f States


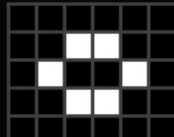
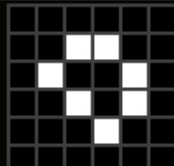

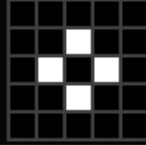
CELLULAR AUTOMATA AS MODELS OF PHYSICS: HOW GLOBAL PATTERNS EMERGE FROM SIMPLE, LOCAL RULES


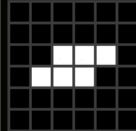
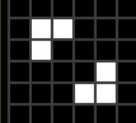
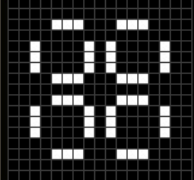
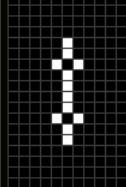
Fixed Law of Motion f

Initial State, S_i  Final State, S_f

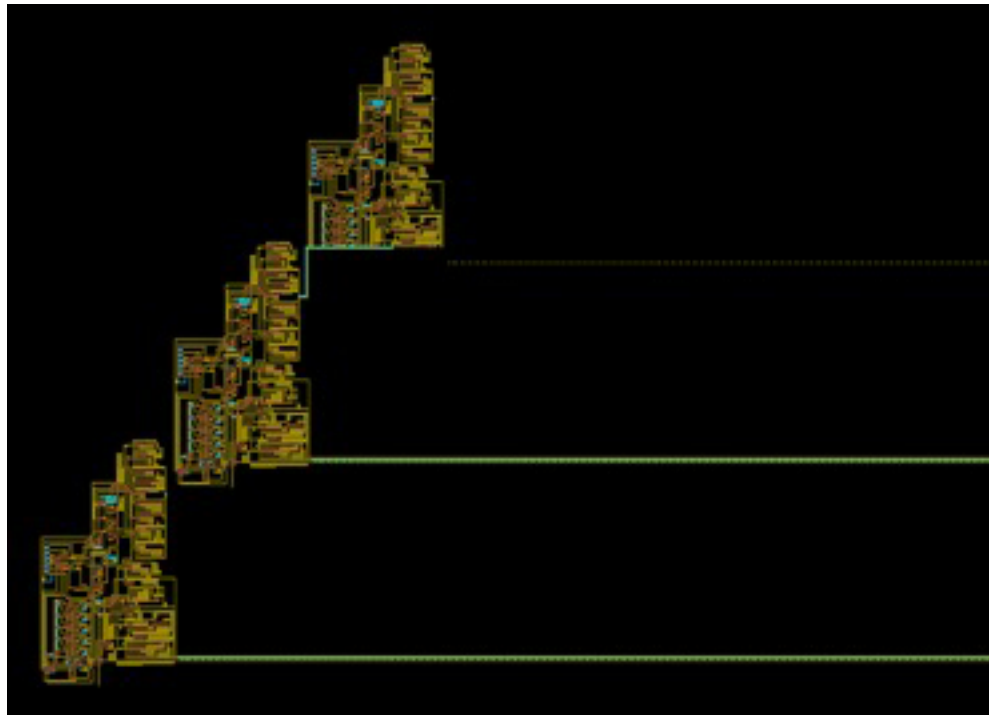


GAME OF LIFE: AN EXAMPLE OF MANY EMERGENT PROPERTIES FROM THE SIMPLE RULE SET

Still lifes	
Block	
Beehive	
Loaf	
Boat	
Tub	

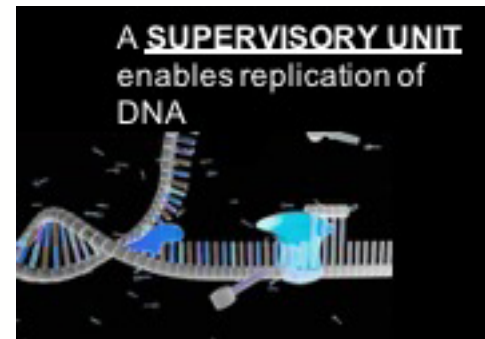
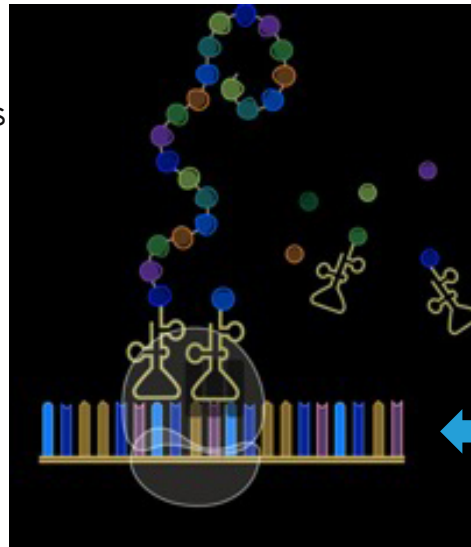
Oscillators	
Blinker (period 2)	
Toad (period 2)	
Beacon (period 2)	
Pulsar (period 3)	
Pentadecathlon (period 15)	

VON NEUMANN: SELF-REPRODUCING AUTOMATA



ARCHITECTURE OF SELF-REPRODUCING “MACHINES”

The ribosome +
assisting biomolecules
act like a **UNIVERSAL**
(well ... sort of)
CONSTRUCTOR



This is an instructional **TAPE**, i.e.,
a small part of a larger biological
algorithm

SELF-REPRODUCING AUTOMATA AS PHYSICAL SYSTEMS: PHYSICAL UNIVERSALITY

“physical” universality: the ability to implement any transformation whatsoever on any finite region

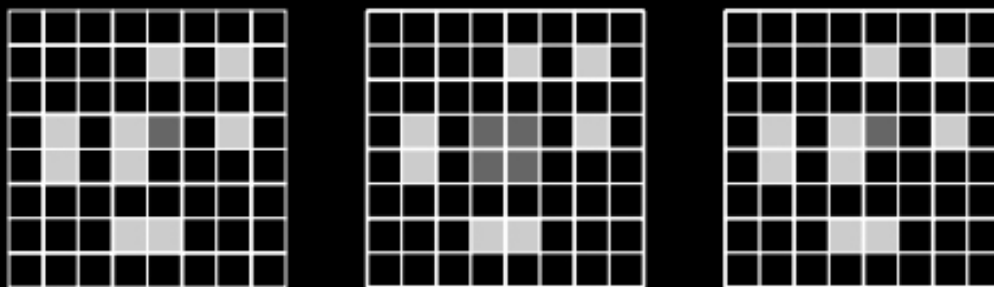
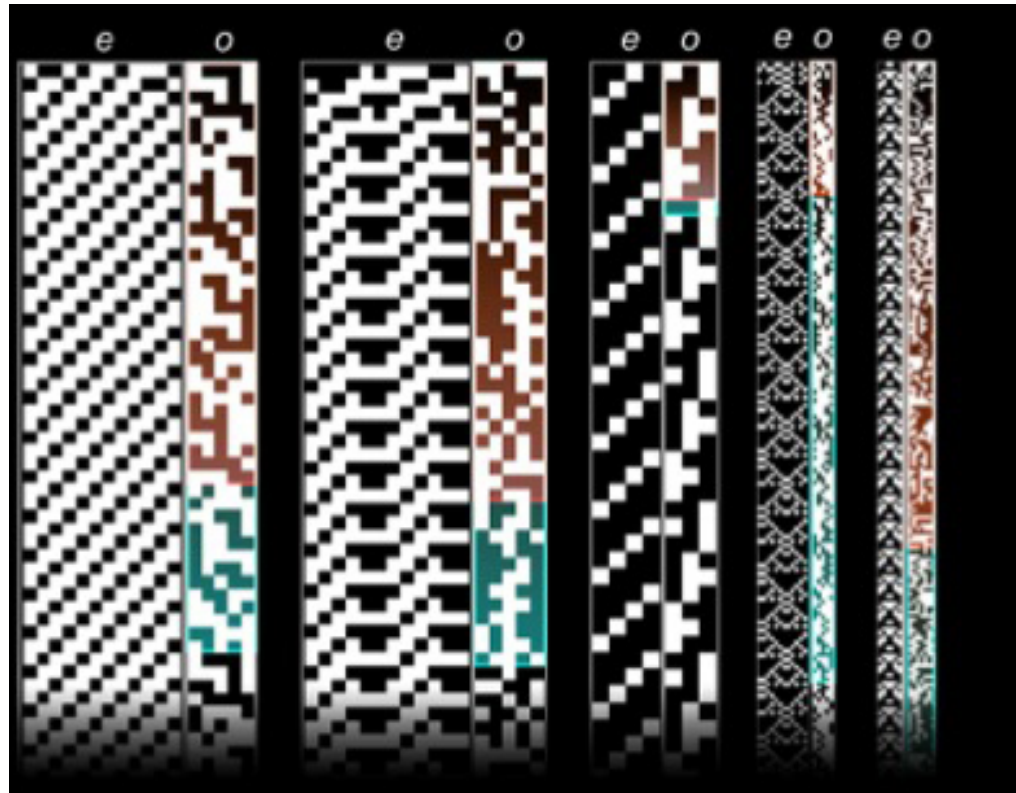


Figure 3: An example of a configuration (left) such that after only three timesteps, the abstract evolution (middle) differs from the minimal consistent configuration (right).



Examples of Case I CA exhibiting OEE. In each panel the environment *e* is shown on the left, and organism *o* on the right. For each *o*, the Poincare recurrence rate for an isolated system is highlighted in blue, and the recurrence time of the states is highlighted in red. (Adams et al (2017), Situation awareness and the cognitive management of complex systems.)

Are the 'laws of life' are the laws of information?

