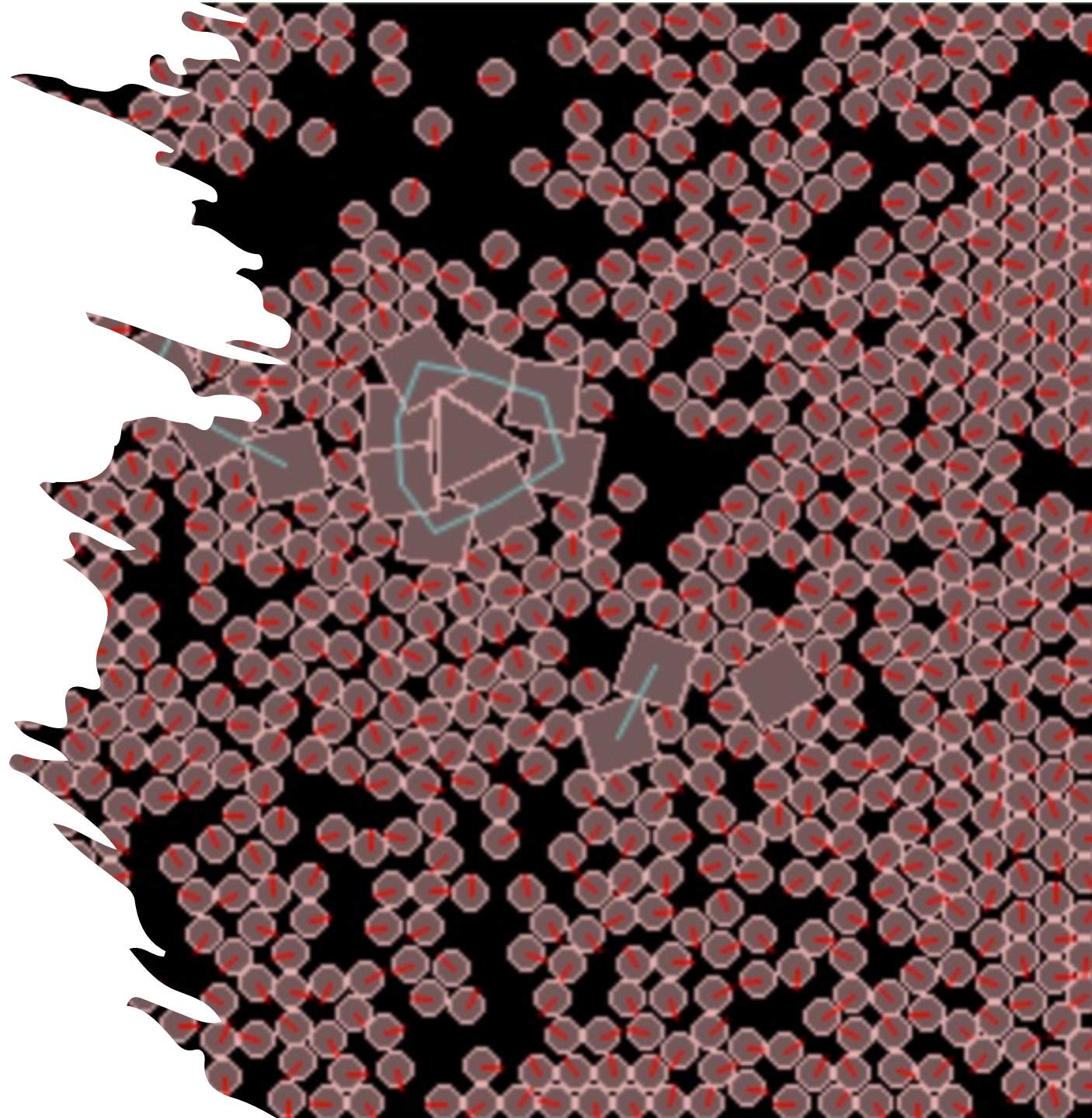


# Liquid Automata

**Dr Steve Battle**  
UWE Bristol

**Festival of  
Unconventional  
Computing and  
Proto-cognition**



# Autopoiesis



From Greek:

- “auto” (self)
- “poiesis” (creation)

*Autopoiesis is synonymous with life.*

# Organisational Closure

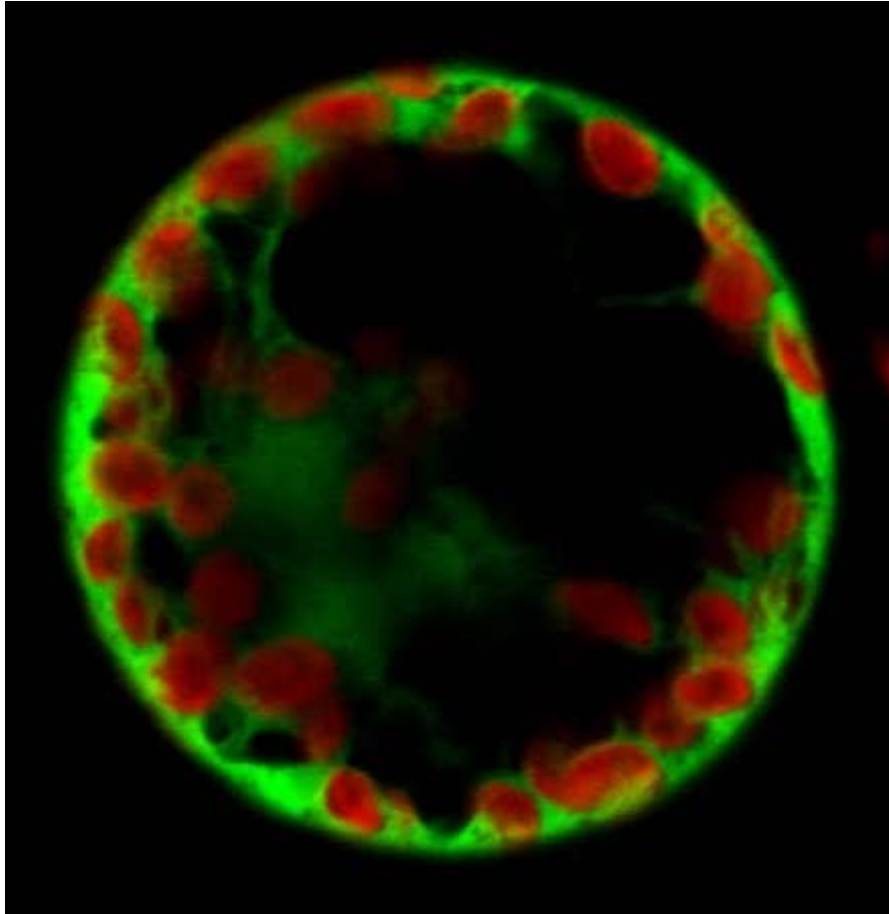


*A network of processes of self-production of components.*

examples:

- *chemical reactions*
- *fire*
- *nuclear bomb*
- *Covid virus*
- *Krebs cycle*

# Structural Closure



*The emergence of a boundary  
dividing self from non-self.*

*examples*

- *cell wall*
- *crystals*
- *soap bubble*
- *corral*



# Living Machines

Life = Organisational Closure  
+ Structural closure

*“A universe comes into being  
when a space is severed into two.  
A unity is defined.”*

Autopoiesis and Cognition:  
The Realization of the Living (1972)



**HUMBERTO MATURANA**  
SANTIAGO, CHILE



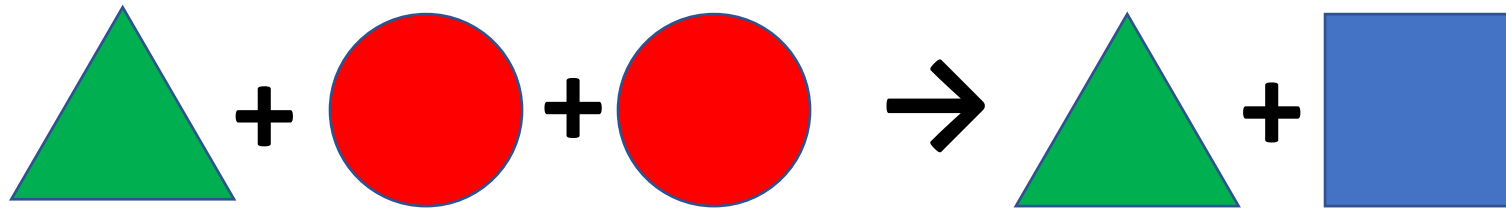
**FRANCISCO VARELA**  
SANTIAGO, CHILE

# Liquid Automaton

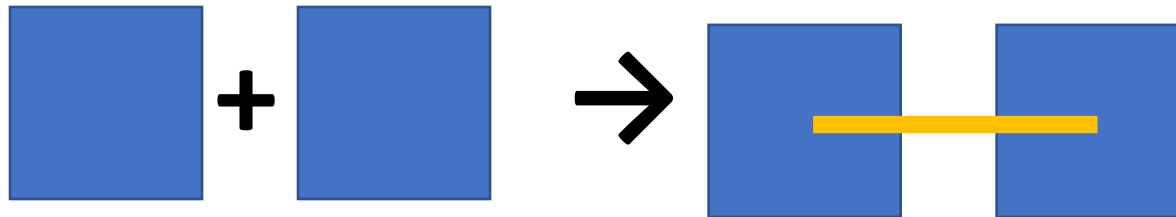


1. Take a game physics engine – the one from “Angry Birds”
2. Add chemistry...

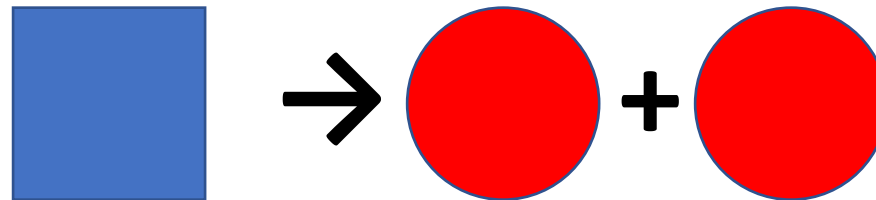
# Artificial Chemistry



composition



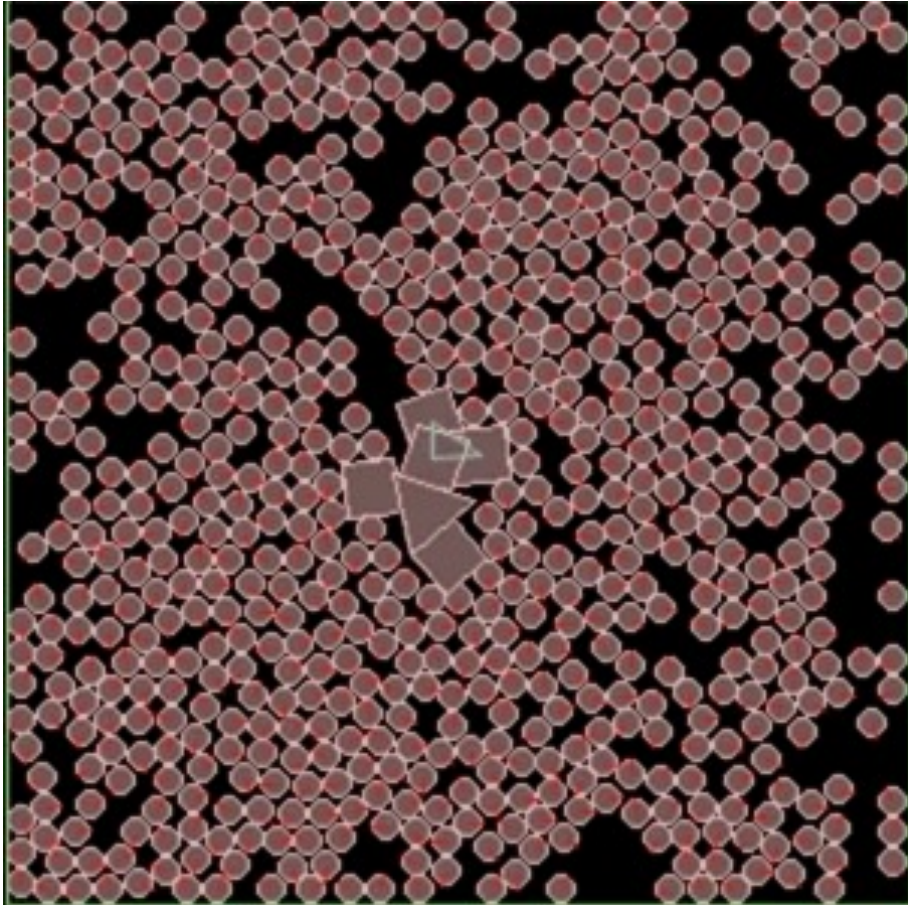
concatenation



disintegration

**Organisation closure**

# Artificial Autopoiesis



- Particles move freely in 2D space.
- React 'chemically' when they collide.
- Closed boundary forms, like a cell wall, enclosing the (triangular) catalyst.



# Conclusion and Question

*“Living systems are cognitive systems, and living as a process is a process of **cognition**. This statement is valid for all organisms, with and without a nervous system.”*

Autopoiesis and Cognition:  
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Is **proto-cognition** a better word?

