

# Synthesizing Emergence

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"That I may detect the  
inmost force, which  
binds the world, and  
guides its course."

"Daß ich erkenne, was  
die Welt  
im Innersten  
zusammenhält."



Faust - Der Tragödie Erster Teil, Nacht  
Goethe, Johann Wolfgang von, 1749-1832



This time lapse movie of the slime mold *Physarum polycephalum* represents 10 days of growth on an agar plate sprinkled with oatmeal flakes. Images were taken at 15 minute intervals.



Cornell University  
College of Agriculture  
and Life Sciences



Emergence is the process of complex pattern formation from more basic constituent parts or behaviors, and manifests itself as an emergent property of the relationships between those elements.

- from wikipedia -

Simple System

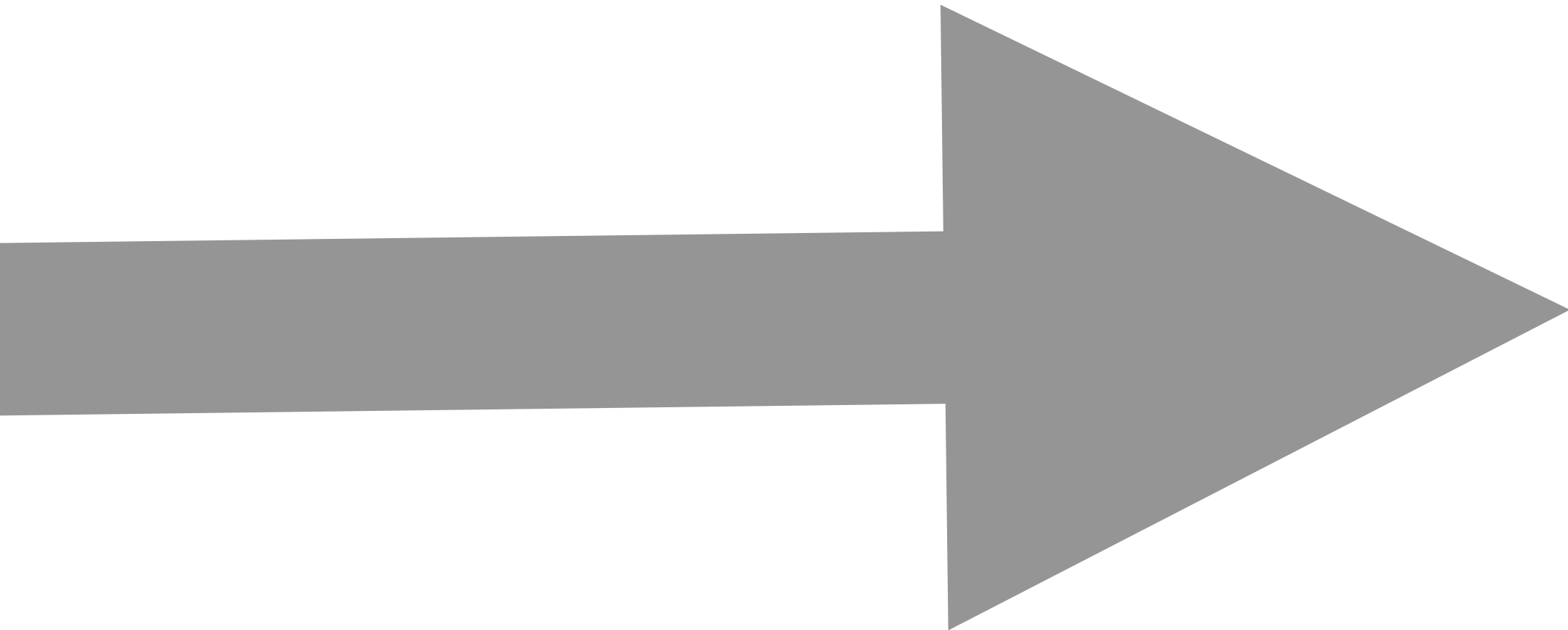
System of Organized Complexity

System of Disorganized Complexity

Weaver's Broad Camps of Scientific Research

**emergence  
analysis**

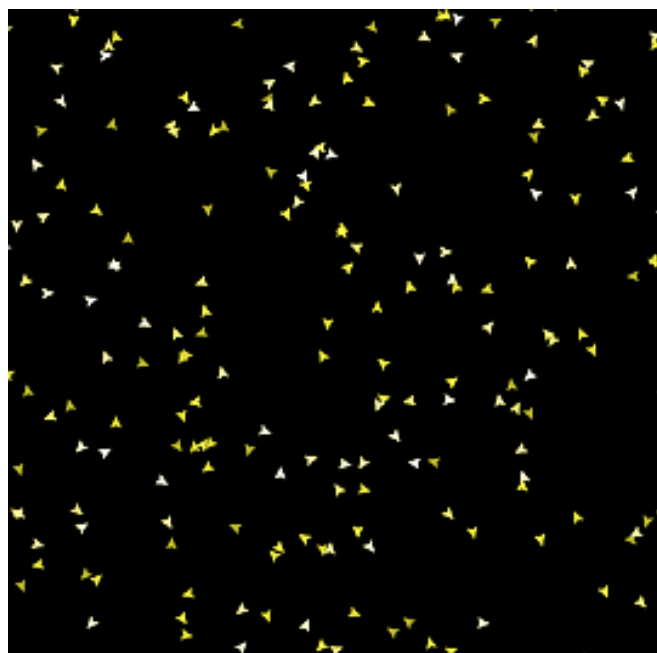
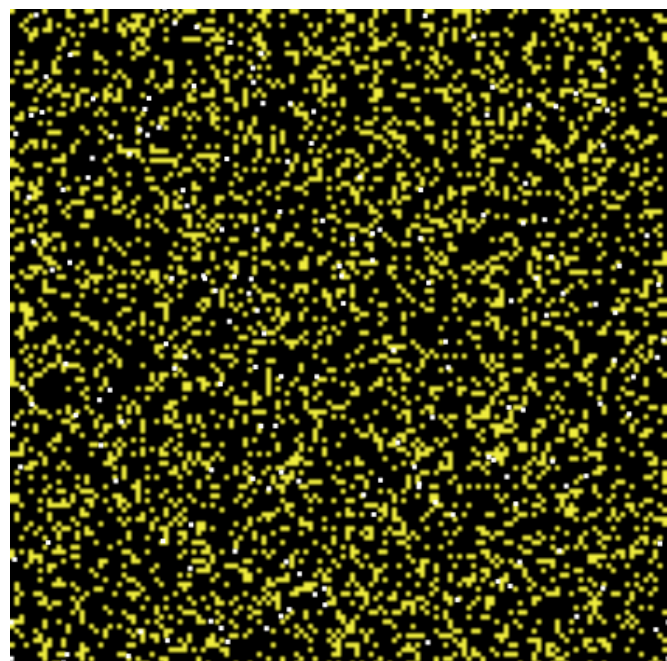
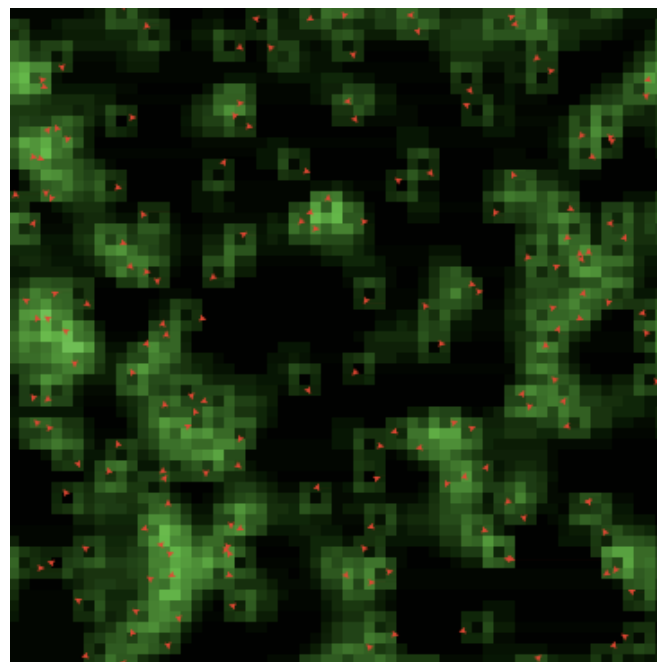
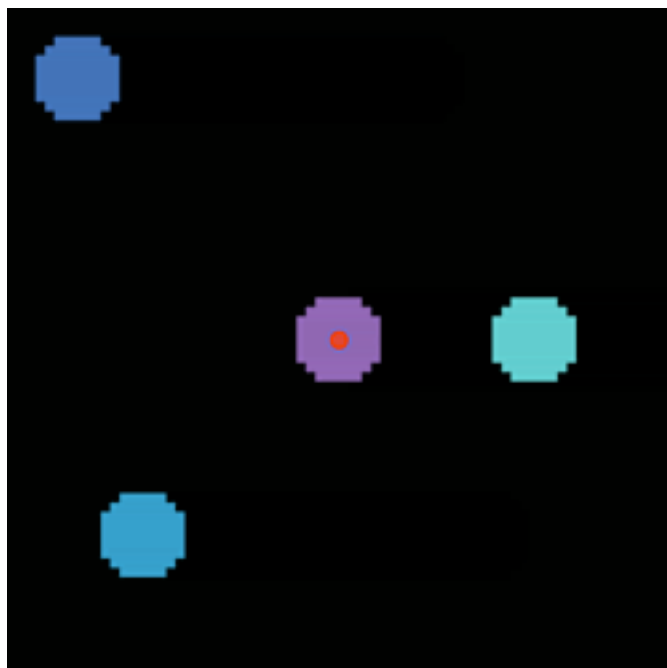
**emergence  
synthesis**





"Ich bin vielleicht  
synthetisch, aber ich  
bin nicht blöde."

Lance Henriksen as Bishop,  
in Aliens, 1986







Größeres Bild

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von Donald E. Knuth

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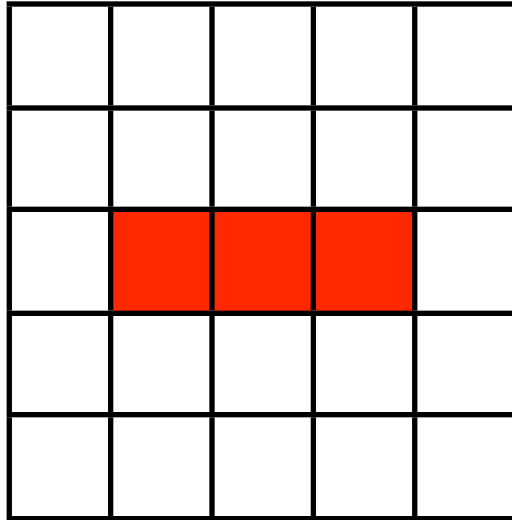
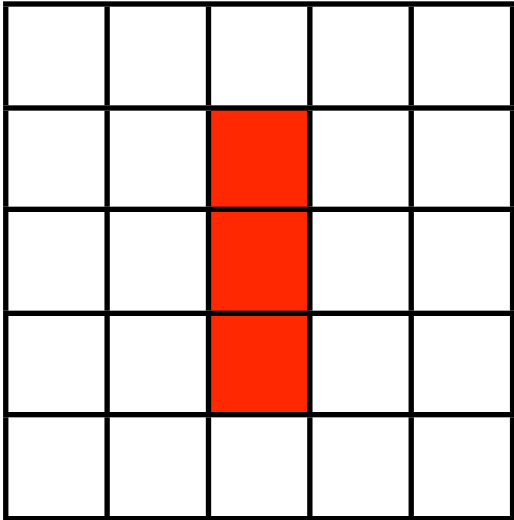




# Conway's Game Of Life

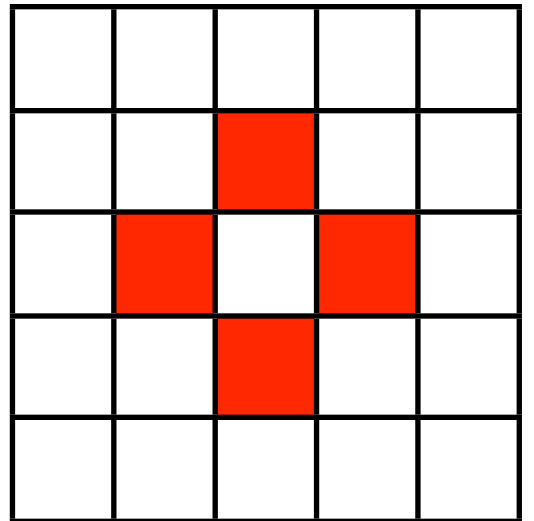
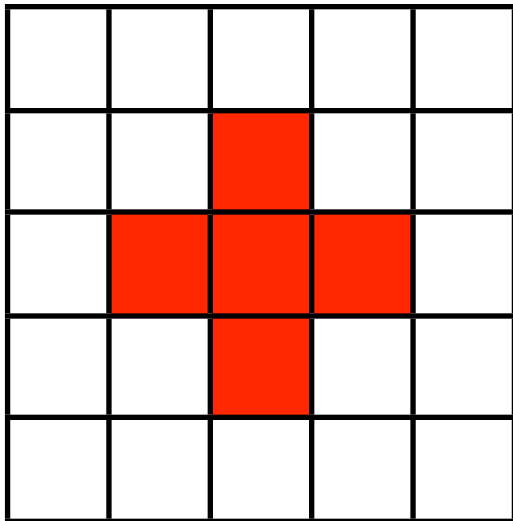
Given an infinite two-dimensional grid of cells.

- Any live cell with fewer than two neighbours dies.
- Any live cell with more than three neighbours dies.
- Any live cell with two or three neighbours lives.
- Any dead cell with exactly three neighbours comes to life.



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Conway's Game of Life

Ant Hill

Flocks

Wikipedia

Hierarchical Systems

Top Down Behaviour

TV Station

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Mail Service

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Schools

“The shape of those clusters  
– with their lifelike irregularity ... –  
is the shape that will define the coming decades.”

Steven Johnson in *Emergence*, 2001, about Mitch Resnick’s Slime Mold Simulation

10

seconds of fame



# homework

1. Identify an hierarchical system
2. Describe it
3. Identify a self-organizing system
4. Describe it



# Agents



# Environment