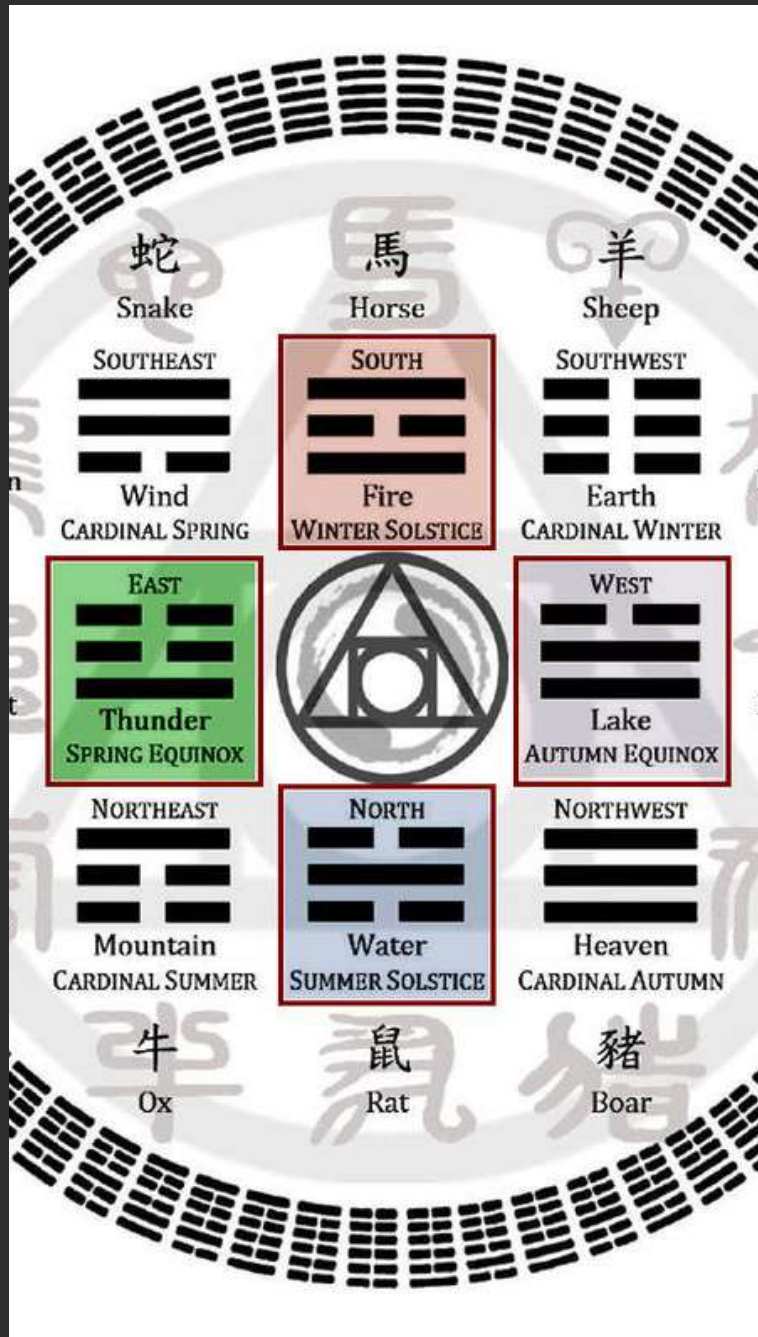


Emergent Digital Ecosystem: Holon and Hierarchy

Why this topic

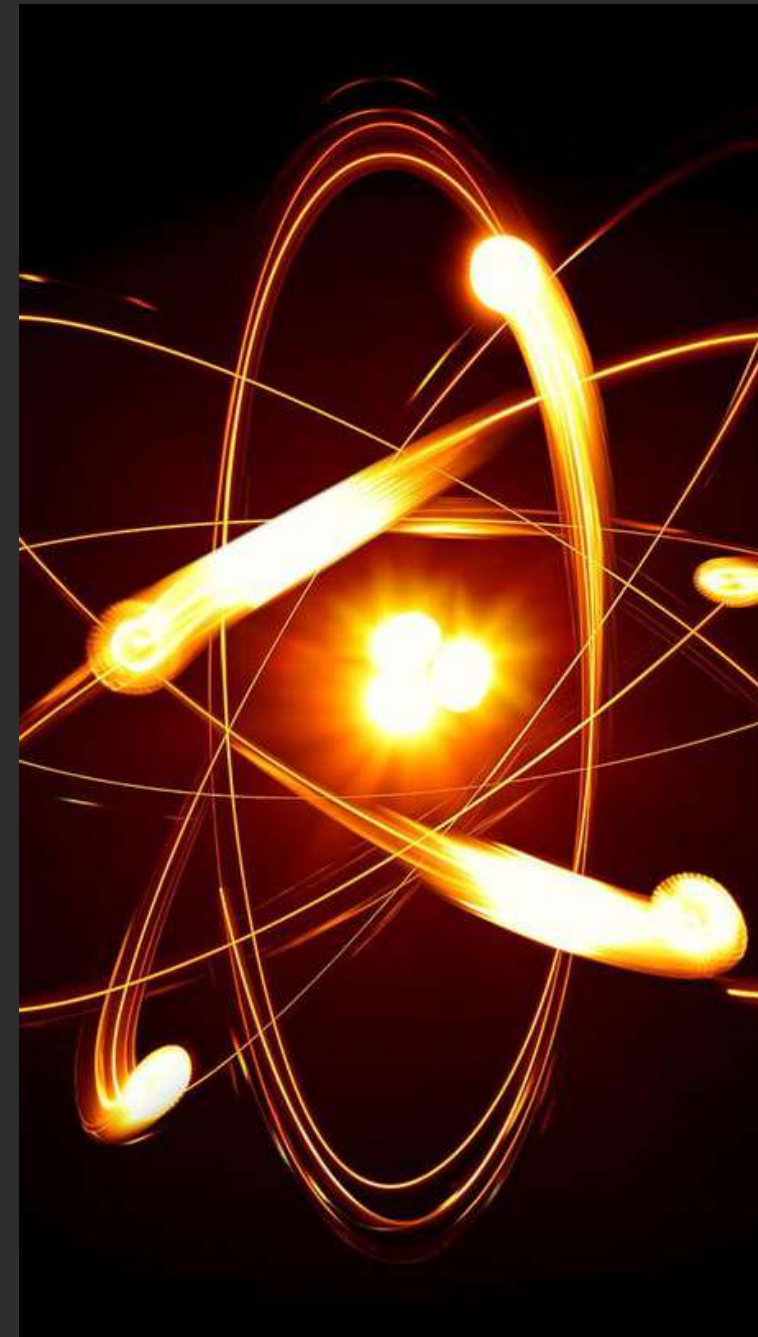
- Many digital systems behave neither fully *mechanical* nor fully *biological*.
- They *sense, respond, evolve, reorganize*.



I-Ching



Fractals



Quantum Physics



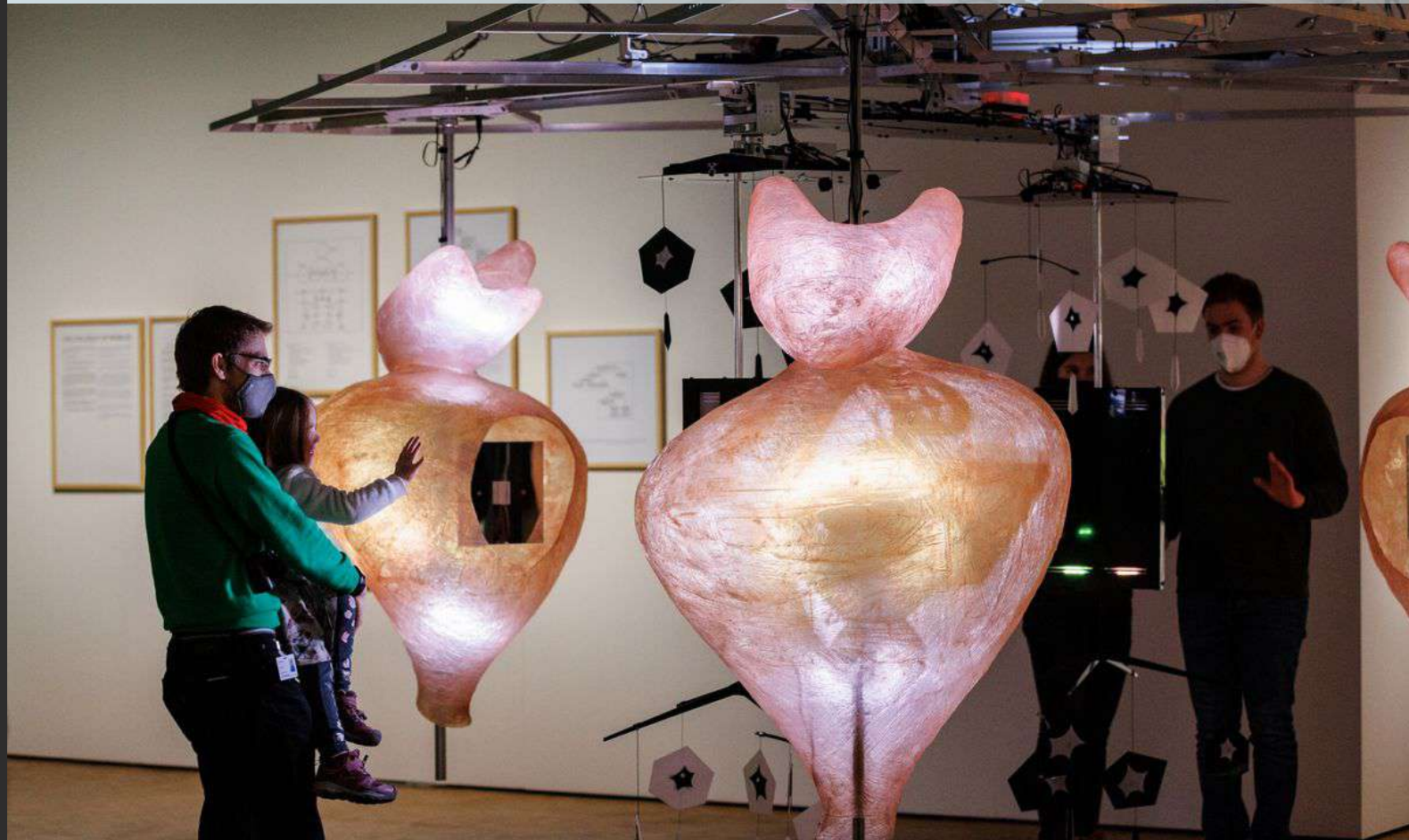
Neural Networks

【BioMedien】



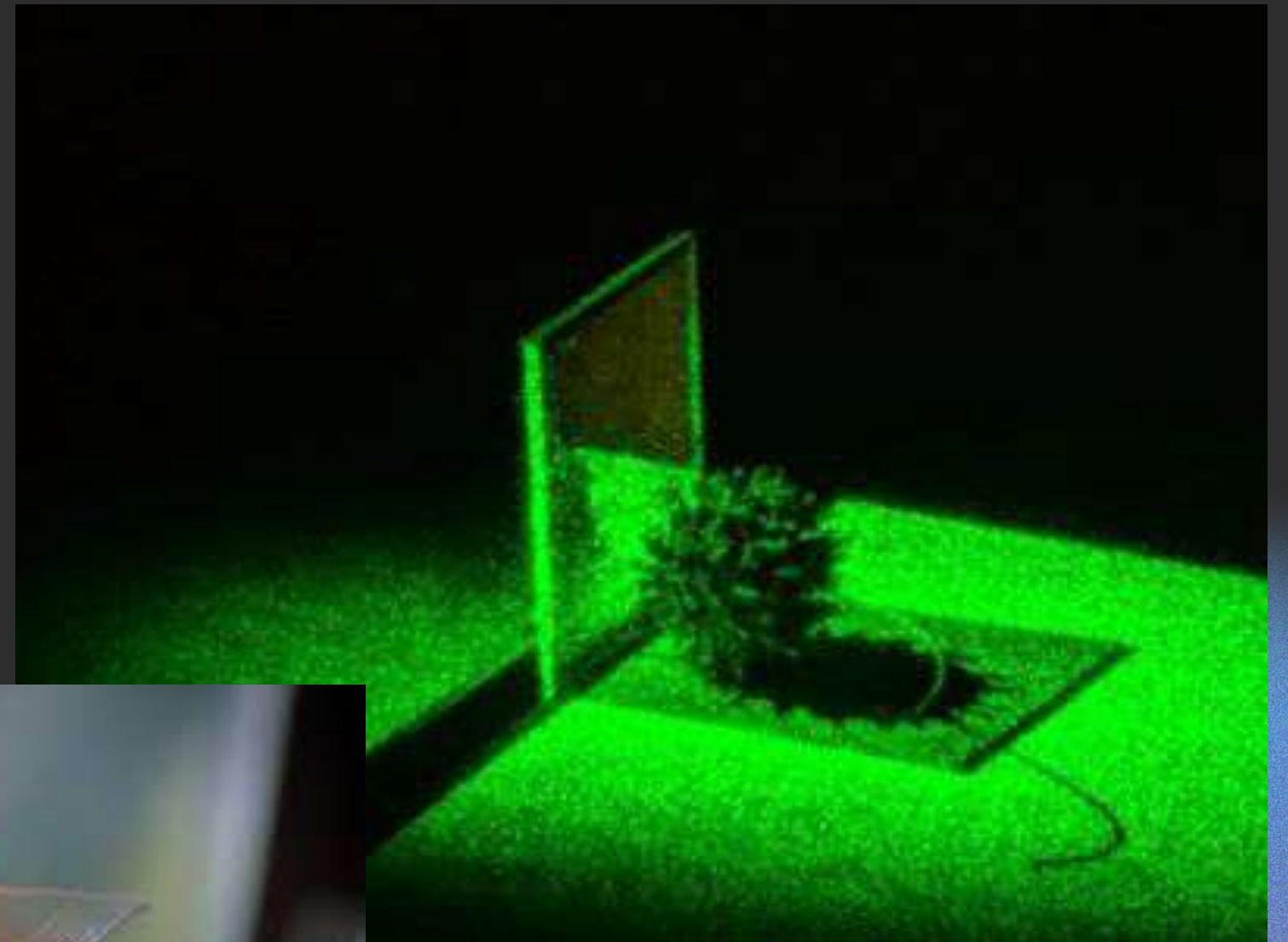
Biomedica (2020)

ZKM | Center for Art and Media Karlsruhe



From Holography to Holon

- Dennis Gabor (1947) — **Holography**
- A light wavefront can store information to reconstruct an entire image.
- In ancient Greek:
 - “holo” = *whole*
 - “-graphy” = *to write*

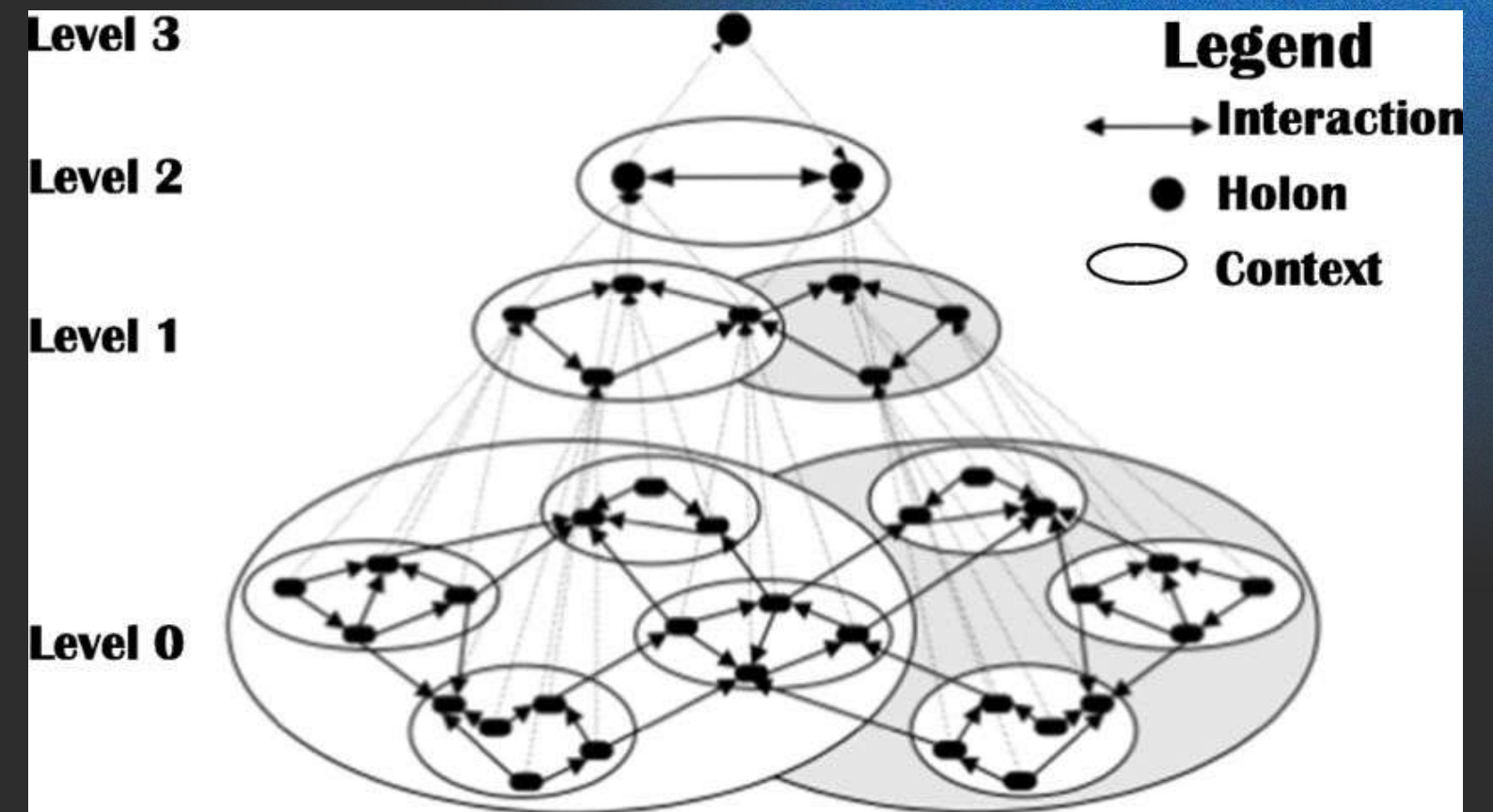


Koestler's Theory: The Holon

- Arthur Koestler (1967) — **Holon**
- *Whole* (“holo”) + *part* (“-on”)
- A holon is both a whole and also a part of a larger whole.

From Holon to Holarchy

- A holon is autonomous but not isolated.
- Internal rules + constraints
 - molecules → cells → organs → organisms
 - agents → swarms → ecosystems
 - neurons → layers → neural networks
- **Holarchy**: a layered system of holons

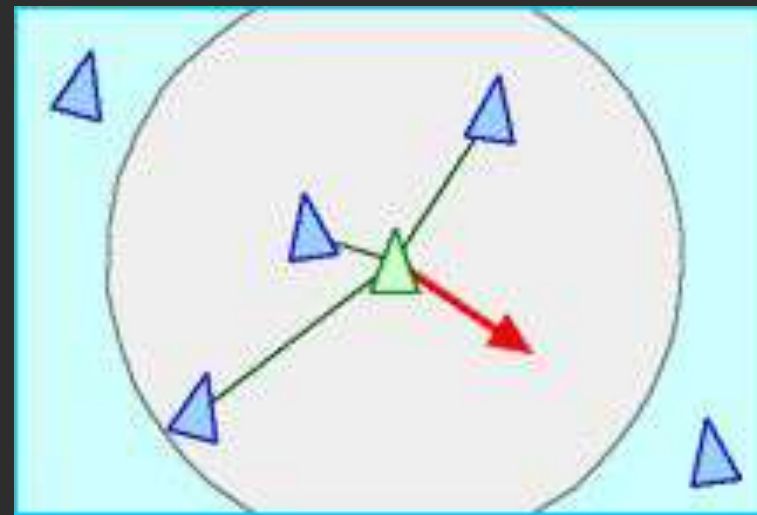


From Holon to Holarchy

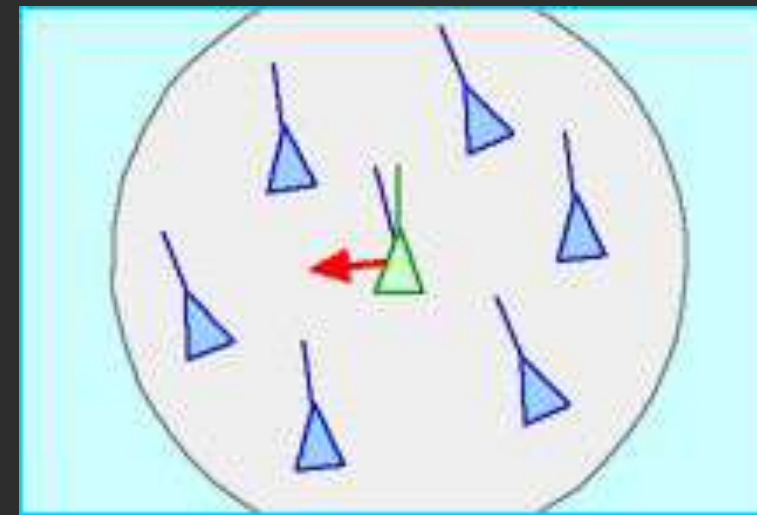
- A holarchy is a **self-organizing structure**
- Complex systems evolve more rapidly when they are organized hierarchically.

Craig Reynolds, *Boids* (1986)

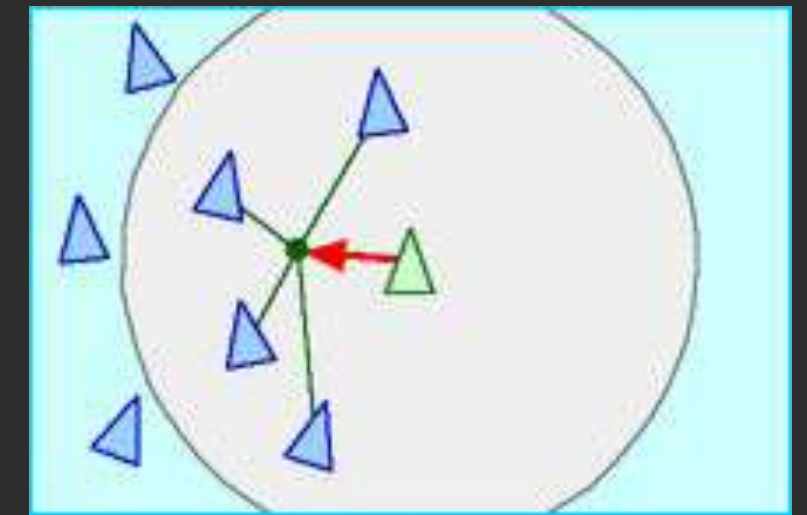
- Artificial life simulation
- Birds flock



Seperation



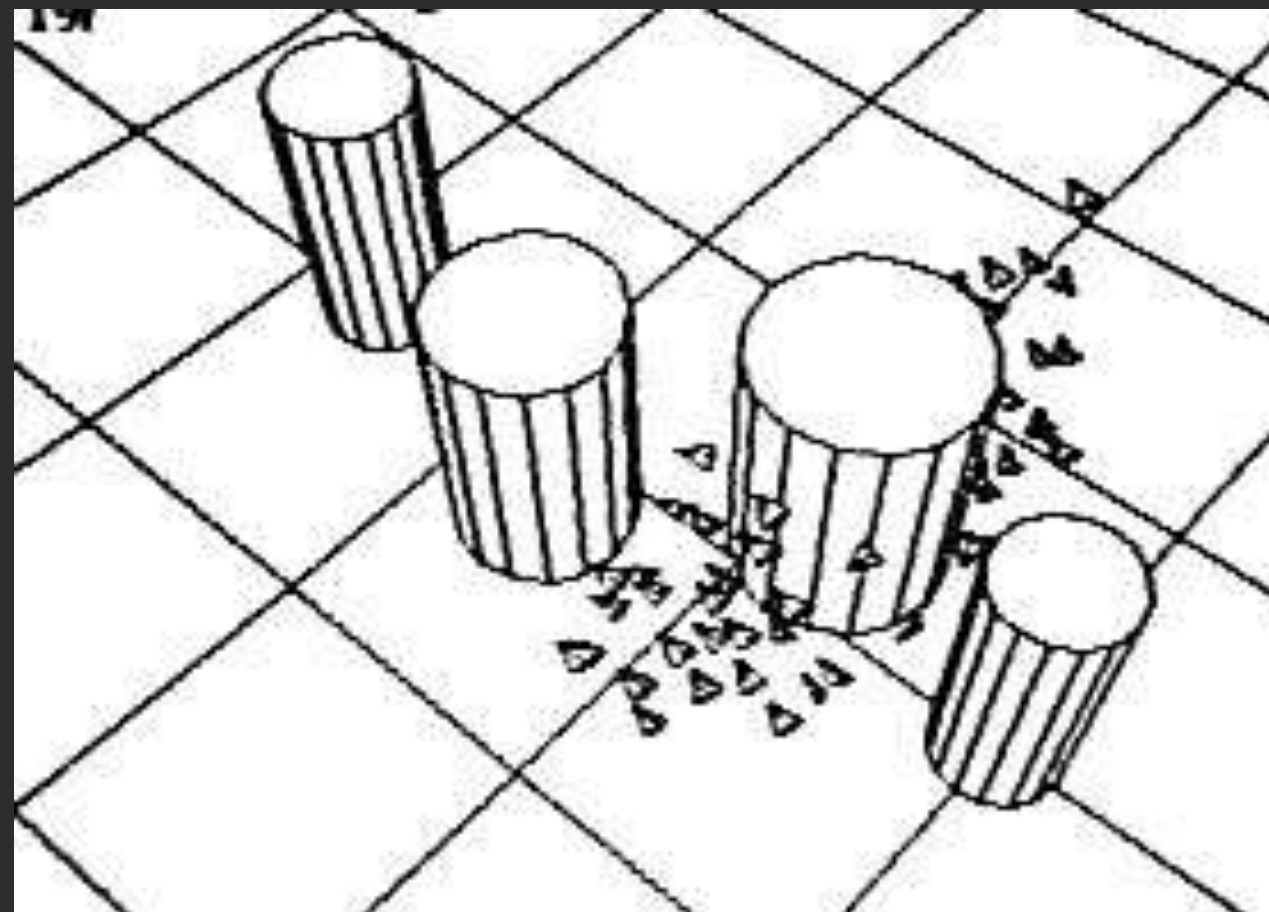
Alignment



Cohesion

- Three rules:
 - Seperation
 - Alignment
 - Cohesion

<https://www.youtube.com/watch?v=86iQIV3-3IA>



https://www.youtube.com/watch?v=3bTqWsVqyzE&list=RD3bTqWsVqyzE&start_radio=1



Why Holon Theory Matters in Digital Ecosystems

- **Digital ecosystems**
 - **independent units**
 - The environment **changes, adapts, reorganizes** over time
 - Distributed information, behavior, and decision-making
 - Collective behavior emerges

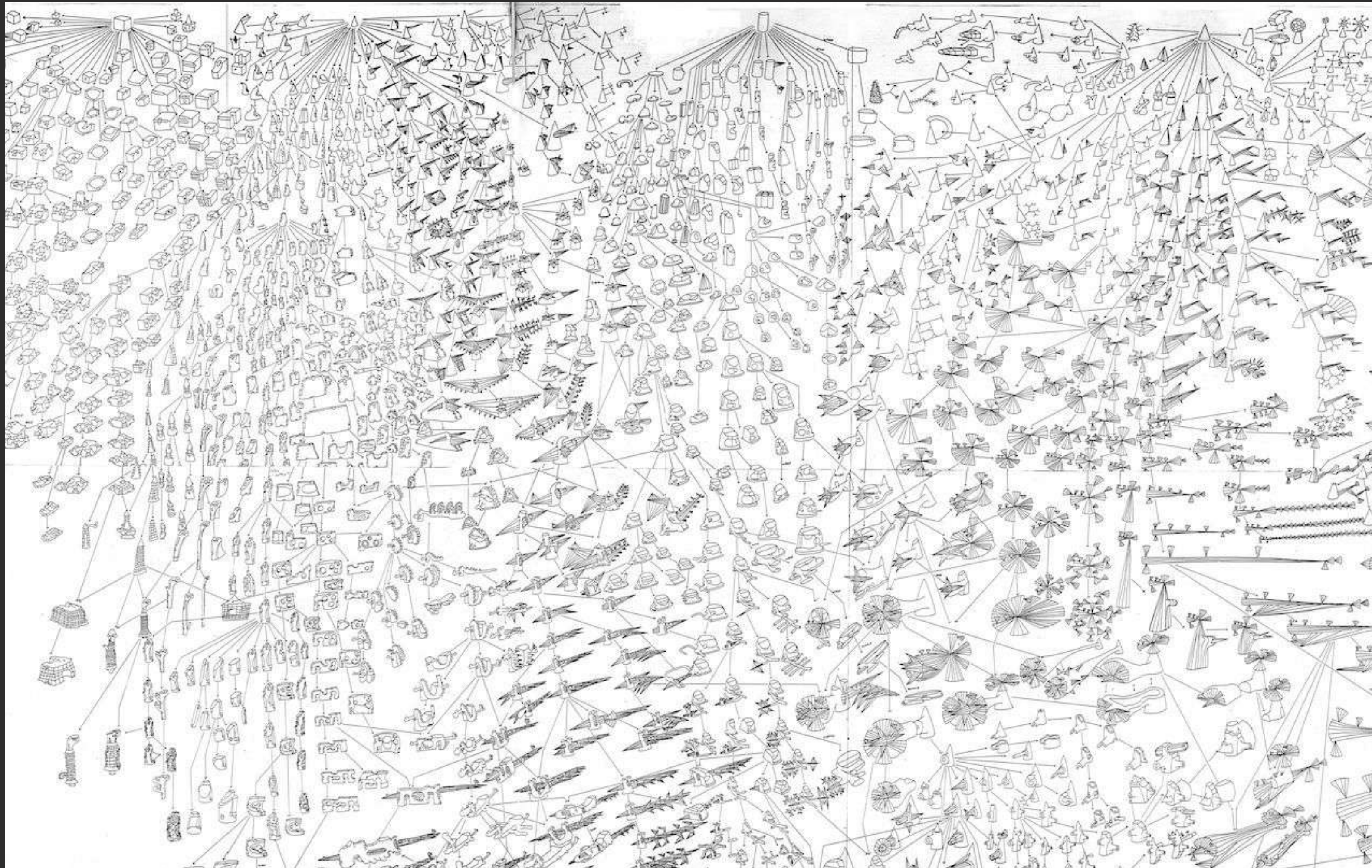
Why Holon Theory Matters in Digital Ecosystems

- **Emergence**

- Arises from self-organization
- **local interactions → global patterns**
- Media systems → dynamic environments → ecosystems

Why Holon Theory Matters in Digital Ecosystems

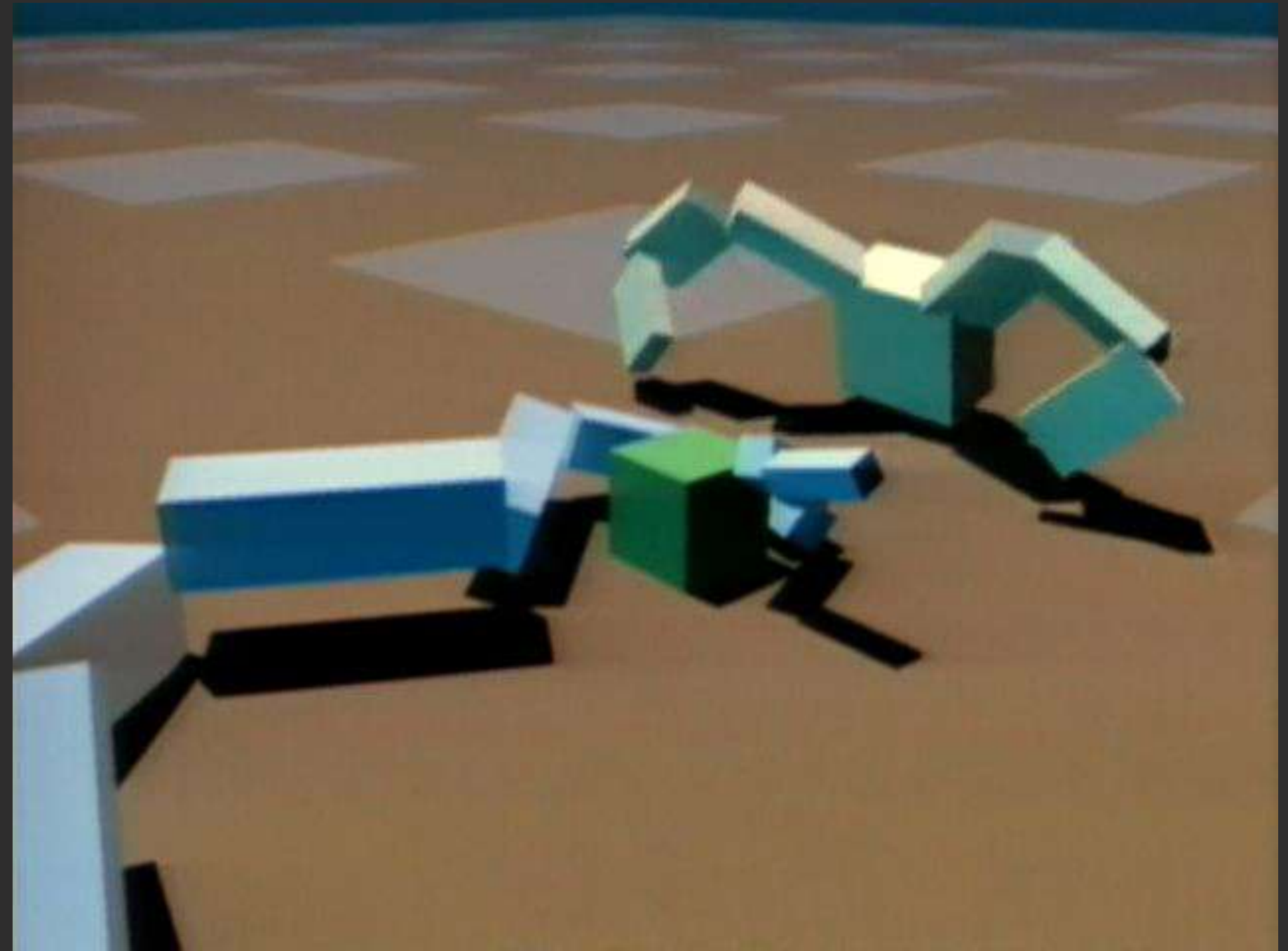
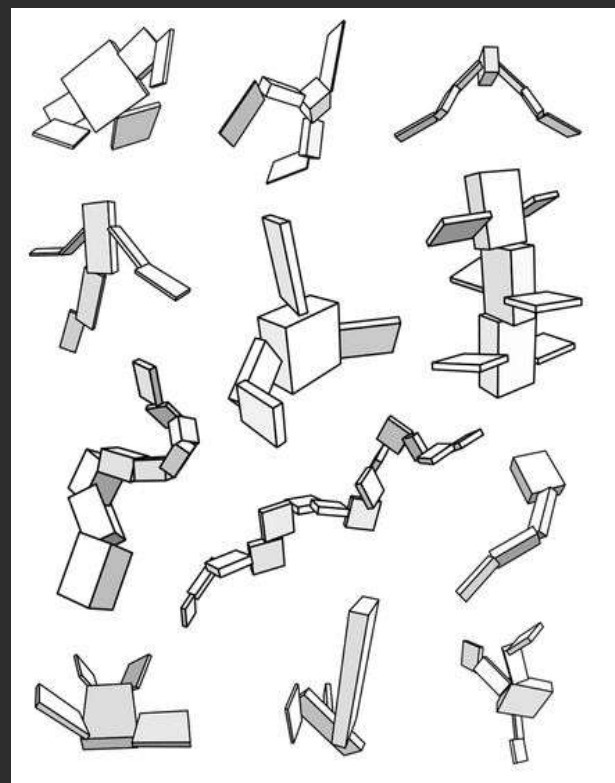
- What makes a system feel *alive*?
- Where does organization come from without central control?
- How do complex digital ecosystems emerge from simple rules or small units of information?



FormSynth Drawing: The Empire of Form (detail). Evolutionary Rule-Based Hand Drawing, Artist: William Latham, 1985-86

Karl Sims, *Evolved Virtual Creatures* (1994)

- Digital evolution + A-life
- *Evolution* → organizing force
- Behaviors emerge through repeated cycles of mutation, selection, and survival.



https://www.youtube.com/watch?v=JBqG_VSP7f8

Rafael Lozano-Hemmer, *Pulse Room* (2006)

- Light bulbs + heart rate + participatory
- *Collective presence* → organizing force
- "Relational media"



<https://www.youtube.com/watch?v=h1i71wnNCE>

Ian Cheng, *Emissaries* (2017)

- Virtual world + AI characters
- *Emergent narratives*
- “Open systems”



Conclusion

- For digital creators...
- For audiences...
- Holon & Holarchy — an ongoing conversation

References

Botar, O. (2014). *Sensing the Future: Moholy-Nagy, Media and the Arts.*

Cheng, I. (2017). *Emissaries.*

<https://iancheng.com/emissaries>

<https://www.moma.org/calendar/exhibitions/3656>

<https://www.youtube.com/watch?v=TO6Luilc4Bo>

Edwards, M. (n.d.). *A Brief History of Holons.*

<http://www.hartford-hwp.com/archives/10/099.html>

Langton, C. G. (1995). *Artificial Life: An Overview.*

Lozano-Hemmer, R. (2006). *Pulse Room.*

https://www.lozano-hemmer.com/pulse_room.php

<https://www.youtube.com/watch?v=h1i71lwnNCE>

Malone, L. (1987). *Stanley & Stella in: Breaking the Ice.*

https://www.youtube.com/watch?v=pbFEQv259yw&list=RDpbFEQv259yw&start_radio=1

Reynolds, C. (1986). Boids.

<https://en.wikipedia.org/wiki/Boids>

<https://www.red3d.com/cwr/boids/>

<https://www.cs.toronto.edu/~dt/siggraph97-course/cwr87/>

Shanken, E. (2009). *Art and Electronic Media.*

Sims, K. (1994). *Evolved Virtual Creatures.*

<https://www.karlsims.com/evolved-virtual-creatures.html>

<https://www.karlsims.com/papers/siggraph94.pdf>

Weibel, P. (2023). *BioMedia: The Age of Media with Life-like Behavior.*

Wiener, N. (1948). *Cybernetics: Or Control and Communication in the Animal and the Machine.*

Wilson, S. (2002). *Information Arts: Intersections of Art, Science, and Technology.*

Thank for Watching

Emergent Digital Ecosystem: Holon and Holarchy

Presented by

Jintong Yang