

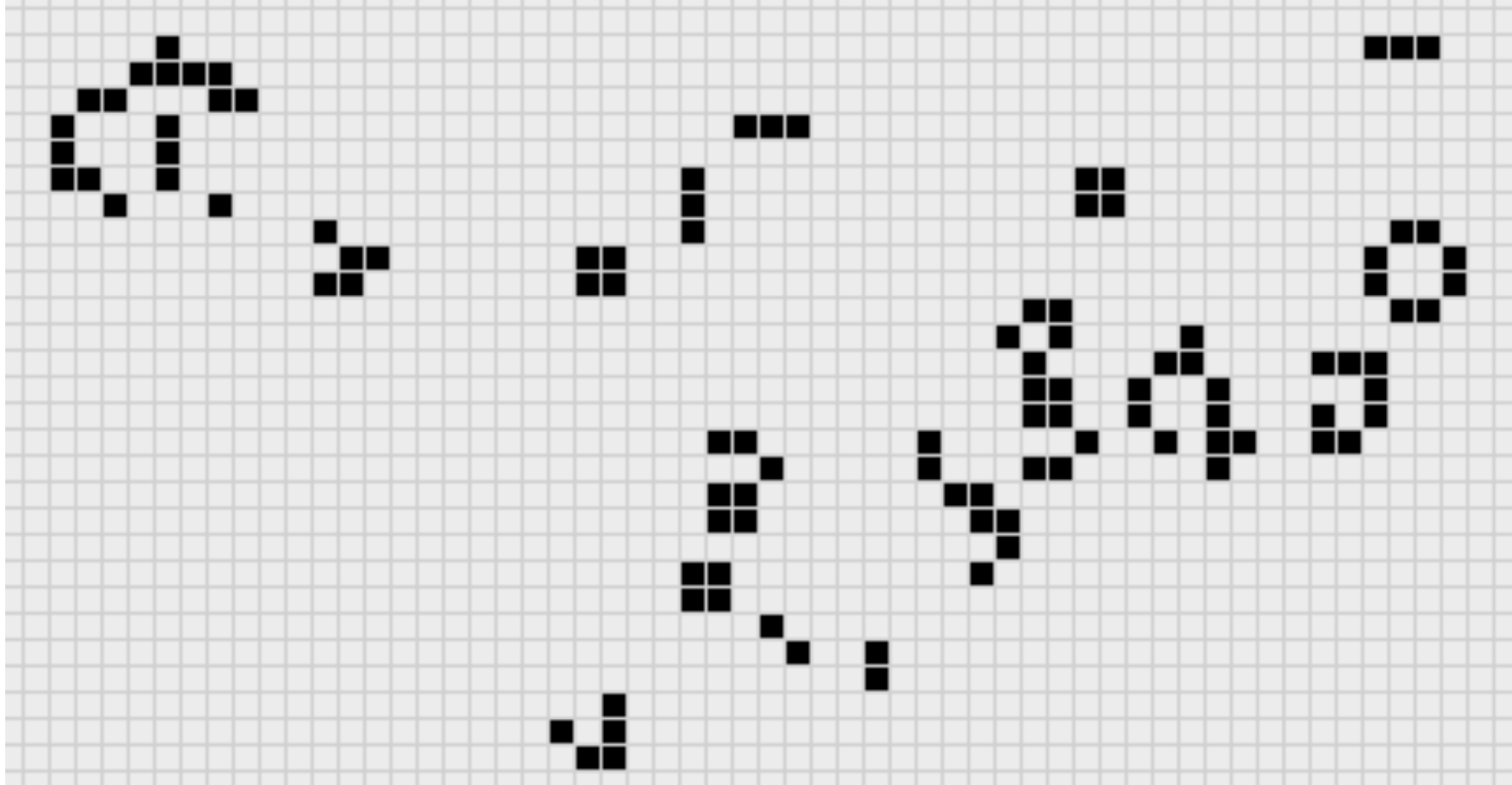
Digital Ontology and Structural Realism

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Digital Ontology

- Digital ontology (Zuse, Fredkin, etc): Physics based on the interaction of bits (“it from bit”).
- Aim: explore structural realism about digital ontology
- This simple case may help illuminate more general issues about structural realism.

Conway's Game of Life



Rules of Life

- Infinite rectangular grid of live/dead cells
- A cell at time $t+1$ is live iff at t it is
 - (i) dead and has 3 live neighbors or
 - (ii) live and has 2 or 3 live neighbors.

Game of Life



Structural Realism: Varieties

- Epistemological structural realism: All knowable scientific truths are structural.
- Conceptual structural realism: All (good) scientific concepts are structural.
- Ontological structural realism: The complete (fundamental) truth about reality is structural.

Structural Truths

- Structural truths: those containing only structural expressions (= expressing only structural concepts), and possibly meeting certain further constraints.

Structural Expressions

- Logical: \sim , $\&$, \exists , $=$, ...
- Mathematical: 0 , \mathbb{R} , \in , ...
- Categorical: object, property, quantity, instantiate
- Nomic: law, cause, power
- Fundamentality: fundamental, natural, ground
- Mereology (?): part

Nonstructural Expressions

- Red, green
- Conscious
- Mass, charge, spin
- Space, time
- Everything else...

Further Constraints

- Structural truths are invariant under (certain) symmetries and translation schemes [all of them? or which, exactly?]
- Structural truths can't concern objects?? [No use of the object quantifier \exists ?
My view: this issue is a red herring.]

Structural Realism: Motivations

- Carnap: objectivity, communicability
- Russell: knowability
- Worrall: continuity
- Ladyman/etc: parsimony, naturalism

Nonstructural Realism about Life

- Liveness = an intrinsic nonstructural property e.g. redness, consciousness
- Deadness = another e.g. blueness, nonconsciousness
- Neighbor = spatial neighbor
- Time = time

Epistemological Structural Realism

- All knowable Life truths are structural
- Liveness and deadness are only known structurally (although they may have some nonstructural nature).
- Space and time too.

Conceptual Structural Realism

- The Life theory is a structural theory
- Liveness and deadness are structurally analyzable concepts
- Space and time too.

Ontological Structural Realism

- The complete truth about the Life world is structural.
- All properties are structural properties.
 - No intrinsic nature for live/dead
 - No special nature for space/time.

How Does Life OSR Work?

- Question: How does ontological structural realism about life work?
- What is the structuralist life universe fundamentally like?
- How can we recover the manifest image from this structural scientific image?

Ramsey Sentence Method

- Ramsify the rules: There are two fundamental properties, L and D [and “neighbor” and “time”?] that satisfy the life rules $R(L,D)$.
- $R(L,D)$: $\mathbb{Z}^* \mathbb{Z}$ grid of L/D objects, an object at time $t+1$ is L iff at t it is (i) D and has 3 L neighbors or (ii) L and has 2 or 3 L neighbors.

Problem for Ramsified OSR

- This is fine for conceptual and epistemological structural realism, but problematic for ontological structural realism
- What are the witnessing properties L,D? (nonstructural properties?)
- Whatever they are, the Ramsey sentence description alone seems incomplete.

Thin Quiddities

- Maybe the witnessing properties are just Lewis's thin quiddities: numerically distinct properties without a further nature?
- But on Lewis's view, there are worlds where these are swapped, contrary to OSR.
- And if they can't be swapped, their necessary connection to roles needs explaining.

Existence Method

- A cell c has L = there's an object at c
- A cell c has D = there's no object at c
- Problem: Doesn't generalize to non-binary quantities or multiple quantities.

Difference Method

- Use same/different as fundamental notions.
- Characterize state at a time in terms of same/difference relations between neighboring cells.
- For nonbinary quantities: use metrics (there exist fundamental metrics $a, b, c \dots$)

Problem: Determinism

- Problem for difference/metric method:
An initial state and its live/dead invert will satisfy the same same/difference characterization.
- But they yield different consequences
- So we can't get deterministic rules this way.

Game of Life



Power Method

- Every cell has one of two fundamental powers:
 - a power L to produce the same power iff 2 or 3 neighbors have the same power, and to produce the other power otherwise
 - a power D to produce the same power iff 0-4 or 6-8 neighbors have the same power and to produce the other power otherwise.
- The most promising strategy for OSR?

Worries

1. Recursive — maybe that's OK.
2. Primitive sameness/difference — OK?
3. Primitive notion of power — OK for nonHumean structural realists.

Humean Structural Realist?

- Powers are OK for a nonHumean, but what should a Humean structural realist say?
- Same/diff state at $t+1$ could depend on state at t and prior states, but we'll still have nondeterminism at $t=1$.
- Maybe $t=1$ and $t=2$ serve as initial conditions?

Function/Quotient Method

- World state is a function from objects (in $Z^*Z^*Z^+$) to $(0, 1)$
- Deterministic and Humean!
- But: $(0, 1)$ is arbitrary. Need to quotient over equivalences between functions from objects to any other ordered pair
- Is quotiented state deterministic and Humean?

What about Objects?

- Treatment so far has taken objects for granted: e.g. there exists an infinite number of objects in Z^*Z structure.
- The quantified fact is primitive, not the witnessing truths about specific objects?
- The objects have only structural properties.

Doing without Objects

- If one wants to dispense with fundamental objects (even quantified over):
- Have state be function from Z^*Z to $(0,1)$ [or: a bipartition of Z^*Z].
- Laws concern evolution of that function.
- Legitimate?

Doing without Space and Time

- Don't mention “time” (or “space”) in rules — just characterize them structurally.
- E.g. world is a function from $Z^*Z^*Z^+$ to $\{0, 1\}$, or a bipartition of $Z^*Z^*Z^+$.
- Rules of life (plus initial conditions) are constraints on the function.

Recovering Space and Time

- How to recover spatiotemporal facts in a structuralist life world?

Spatiotemporal Functionalism!

- Time = dimension of determination (one that yields useful dynamic equations)
 - The Z^+ dimension
- Distance = what there's less action at (nexus of causal interaction)
 - The “neighbor” metric on Z^*Z

Structural Realism and Spacetime Functionalism

- I think: any wholehearted structural realist should be a spacetime functionalist, to avoid taking nonstructuralist notions of space and time as fundamental.

Recovering Observation

- There's always a gap between structure and consciousness (unless one is functionalist about consciousness)
- But one can assume bridging principles, e.g. square structures look square (or: certain processes yield square experiences) to recover observation and experience.

Options for Consciousness

- Ontological structural realism about consciousness (functionalism)
- Ontological structural realism about physics, nonstructuralism about consciousness (property dualism)
- Epistemological structural realism about physics, with consciousness as realizer (panpsychism)

Life and Levels

- As with any physical theory, the Life theory could turn out to be nonfundamental, realized by lower levels.
- If structural realism about Life is correct, to realize Life, the lower levels must simply embody the right structure.

Simulation and Realization

- Any computer running the Life program will realize the structural Life theory.
- So any simulated Life world will be a (nonfundamental) Life world.

Structural Realism and Skepticism

- So: a putatively skeptical scenario that we live in a merely simulated Life world is one where the Life theory is correct.
- Structural realism makes skepticism about science (and about reality more generally) harder to sustain!

Conclusion

- Some versions of ontological structural realism may be true in some Life worlds.
- What follows for actuality?