Strong Determinism

Paper version: arXiv 2203.02886

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Definitions:

- A possible world w: a four-dimensional spacetime and its (material) contents
- The actual world α: the actual spacetime and its contents
- Ω^T: the set of possible worlds that satisfy the fundamental laws specified in theory T.
- Ω_α: the set of possible worlds that satisfy the actual fundamental laws obtaining in α, i.e. the set of all physically / nomologically possible worlds.

Determinism$_T$ Theory T is *deterministic* just in case, for any two $w, w' \in \Omega^T$, if w and w' agree at any time, they agree at all times.

Determinism$_\alpha$ The actual world α is *deterministic* just in case, for any two $w, w' \in \Omega_\alpha$, if w and w' agree at any time, they agree at all times.

Strong Determinism$_T$ Theory T is strongly deterministic if $|\Omega^T| = 1$, i.e. its fundamental laws are compatible with exactly one possible world.

Strong Determinism$_\alpha$ The actual world α is strongly deterministic if $\Omega_\alpha = \{\alpha\}$.

Features of strong determinism: (1) strong explanation and PSR; (2) causation and counterfactuals; (3) strong prediction; (4) other philosophical implications (naturalness, laws, free will, modal realism).

Toy Example #1: An Aristotelian spacetime, with an absolute spatial center x_0 and a lone particle whose only property is position. It is a fundamental law that the particle is located at x_0 at any time.

Toy Example #2: The Mandelbrot world, where it is a fundamental law that the matter distribution is given by the simple rule that generates the Mandelbrot set.

The Everettian Wentaculus is a more realistic example. It has two fundamental laws:

1. The von Neumann equation, $i\hbar\frac{d\hat{W}(t)}{dt} = [\hat{H}, \hat{W}]$, dictates how a fundamental density matrix changes in time.
2. The Initial Projection Hypothesis (IPH), $\hat{W}_{IPH}(t_0) = \frac{\mathbb{I}_{PH}}{dim\mathscr{H}_{PH}}$, where $\mathscr{H}_{PH}$ denotes the Past-Hypothesis subspace in the Hilbert space, pins down a unique initial density matrix of the universe.

The Everettian Wentaculus is strongly deterministic; it allows exactly one nomologically possible history of the multiverse — the actual one. Theoretical virtues: (1) no fundamental probability; (2) nature of the quantum state; (3) fundamentality of physical spacetime; (4) compatibility with Humean supervenience; (5) elimination of nomic vagueness; (6) unification.

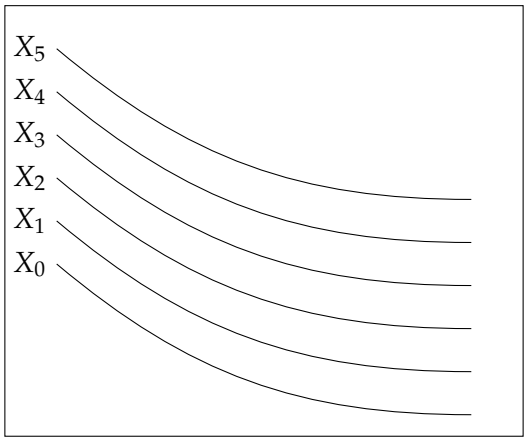

Figure 1: Schematic illustration of a deterministic theory T. Ω^T contains six nomologically possible worlds that do not cross in state space.

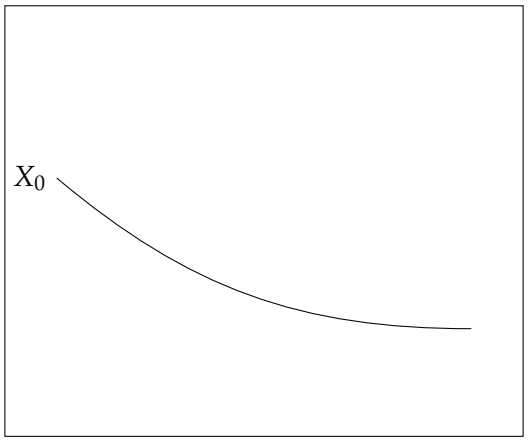

Figure 2: Schematic illustration of a strongly deterministic theory T. Ω^T contains exactly one nomologically possible world.

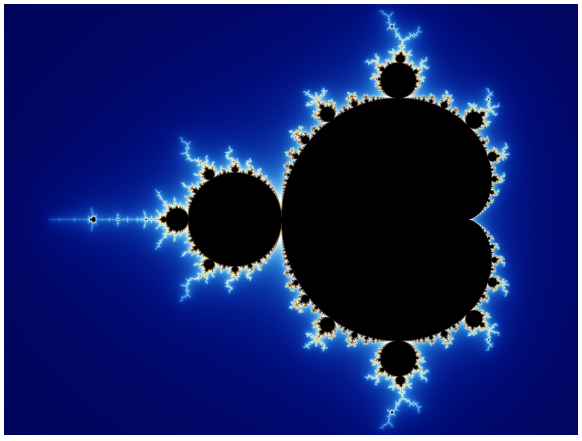

Figure 3: The Mandelbrot set with continuously colored environment. Picture created by Wolfgang Beyer with the program Ultra Fractal 3, CC BY-SA 3.0, https://creativecommons.org/licenses/by-sa/3.0, via Wikimedia Commons