

Definition.

Determinism is true of the *world* if and only if, given a specified way things are at a time t , the way things go *thereafter* is fixed as a matter of *natural law*.

(Stanford Encyclopedia of Philosophy, Entry on Causal Determinism)

Laplace's Demon.

"We ought to regard the present state of the universe as the effect of its antecedent state and as the cause of the state that is to follow. An intelligence knowing all the forces acting in nature at a given instant, as well as the momentary positions of all things in the universe, would be able to comprehend in one single formula the motions of the largest bodies as well as the lightest atoms in the world, provided that its intellect were sufficiently powerful to subject all data to analysis; to it nothing would be uncertain, the future as well as the past would be present to its eyes. The perfection that the human mind has been able to give to astronomy affords but a feeble outline of such an intelligence. Discoveries in mechanics and geometry, coupled with those in universal gravitation, have brought the mind within reach of comprehending in the same analytical formula the past and the future state of the system of the world. All of the mind's efforts in the search for truth tend to approximate the intelligence we have just imagined, although it will forever remain infinitely remote from such an intelligence."

(1820)

(Essai Philosophique sur les Probabilités)

Principle of Sufficient Reason - Leibniz

"Free Will is an illusion" - Spinoza

Heisenberg Uncertainty Principle

Gödel's Incompleteness Theorem

$$\left\{ \begin{array}{l} \dot{x} = f(x, t) \\ x(0) = x_0 \end{array} \right\} \quad * \quad \begin{array}{l} x \in \mathbb{R}^n \\ \text{Chaos is impossible if } n < 3 \end{array}$$

To "solve" this IVP means to find a function $x(t)$ that satisfies (A).

- analytical solution : use MATH
- numerical solution : use computer

A solution may exist for all $t \in \mathbb{R}$
or for a subset of \mathbb{R}