Causation and dynamics

Gábor Hofer-Szabó

Research Centre for the Humanities, Budapest

Joint paper:

- Péter Fazekas, Balázs Gyenis, Gábor Hofer-Szabó and Gergely Kertész, *A dynamical systems approach to causation*, (submitted)

Two types of causal analysis

I. Conceptual analysis

- Analyzes the truth conditions of everyday causal parlance
- Counterfactual, difference making, INUS theories
- Problem: do not connect well with scientific theories

II. Empirical analysis

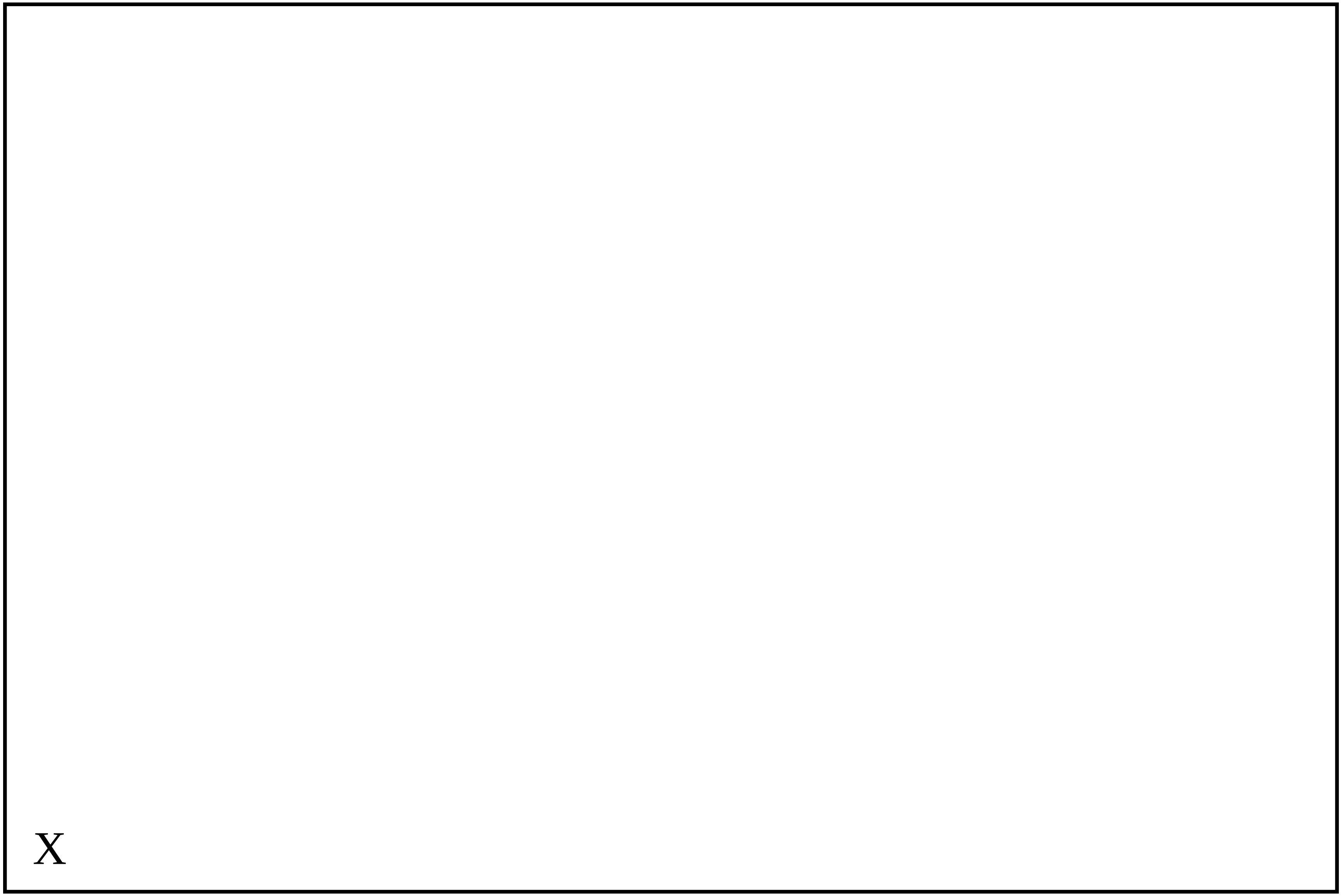
- Captures the objective relations underlying causal claims
- Mark transmission, conserved quantity theories
- Problem: do not connect well with everyday causal discourse

A dynamical systems approach to causation

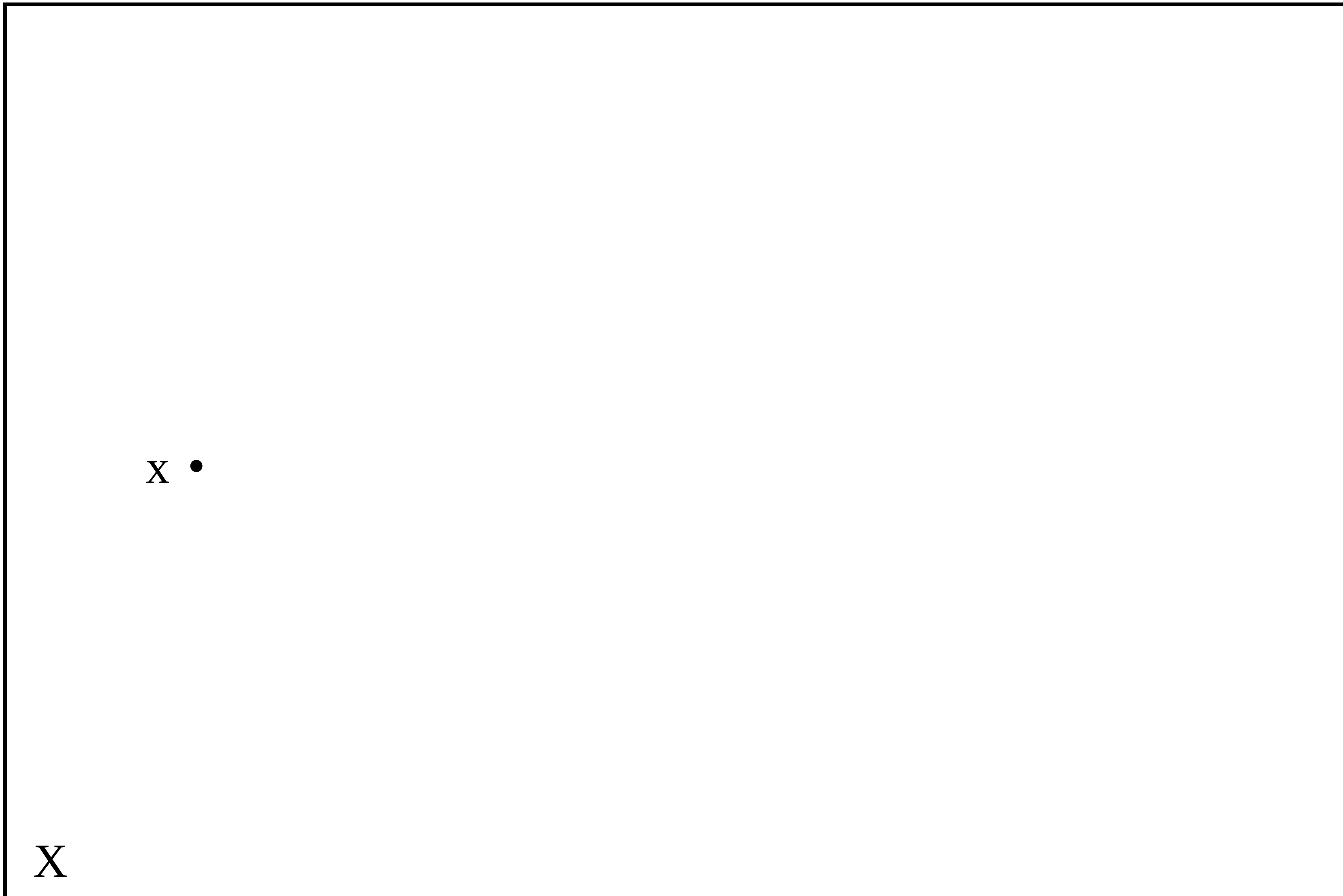
Our approach combines both analyses:

- It is based on the theory of dynamical systems applied in statistical mechanics; and
- accounts for such problems of the conceptual analysis as
    - causally relevant factors
    - *the* cause
    - token-type causation
    - overdetermination
    - preemption
    - prevention
    - omission

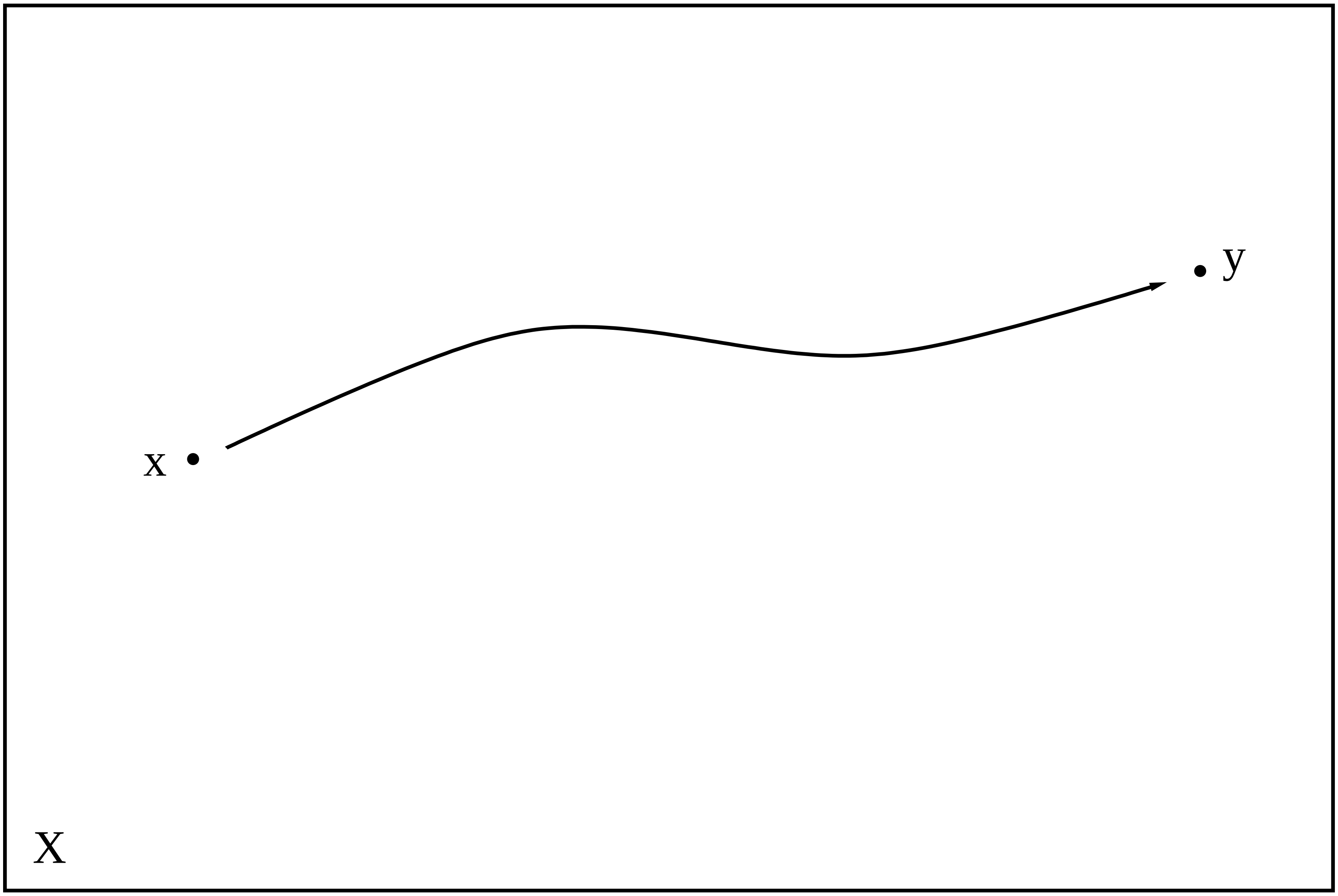
State space: the set of possible states



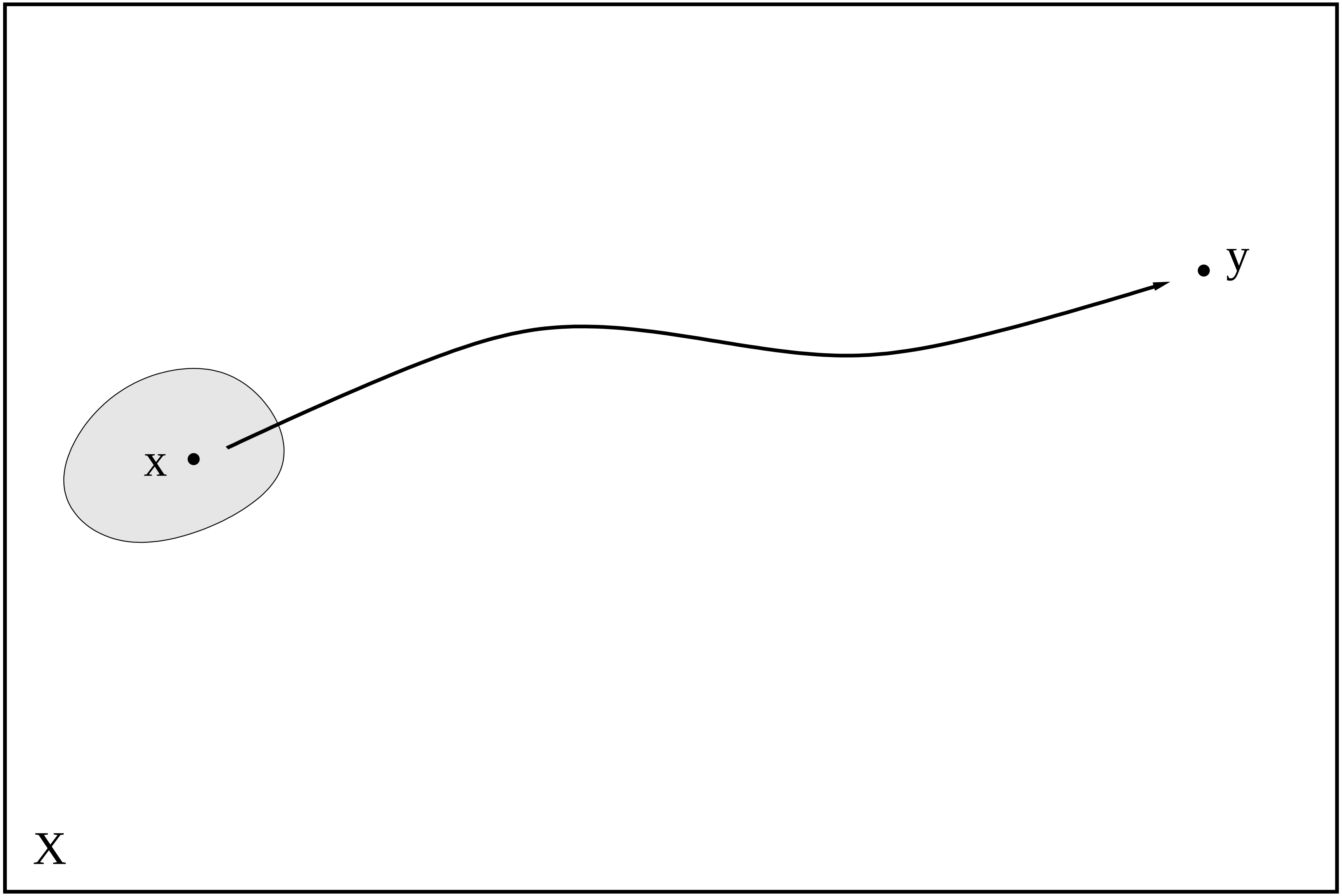
State of the system



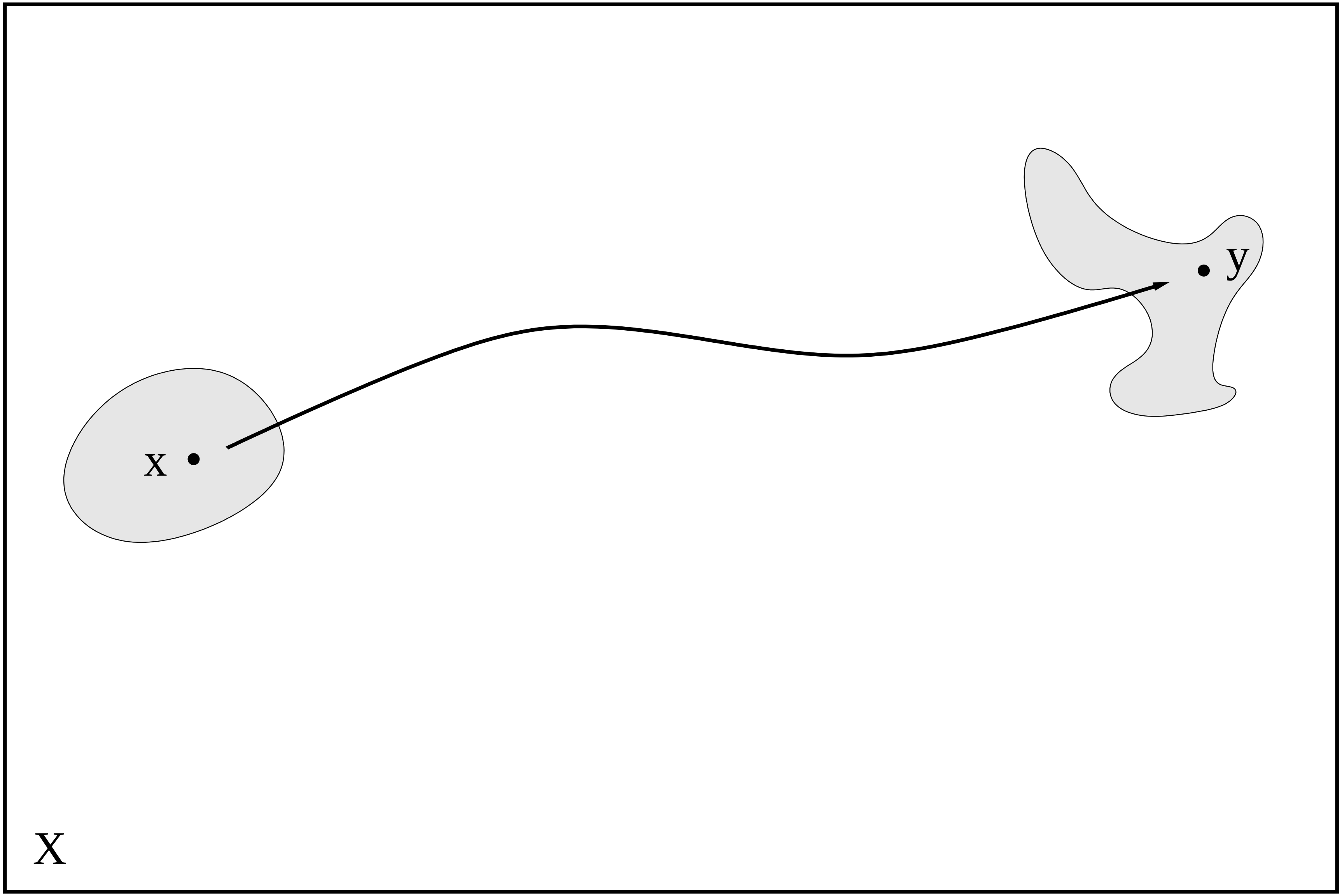
Dynamics: time evolution



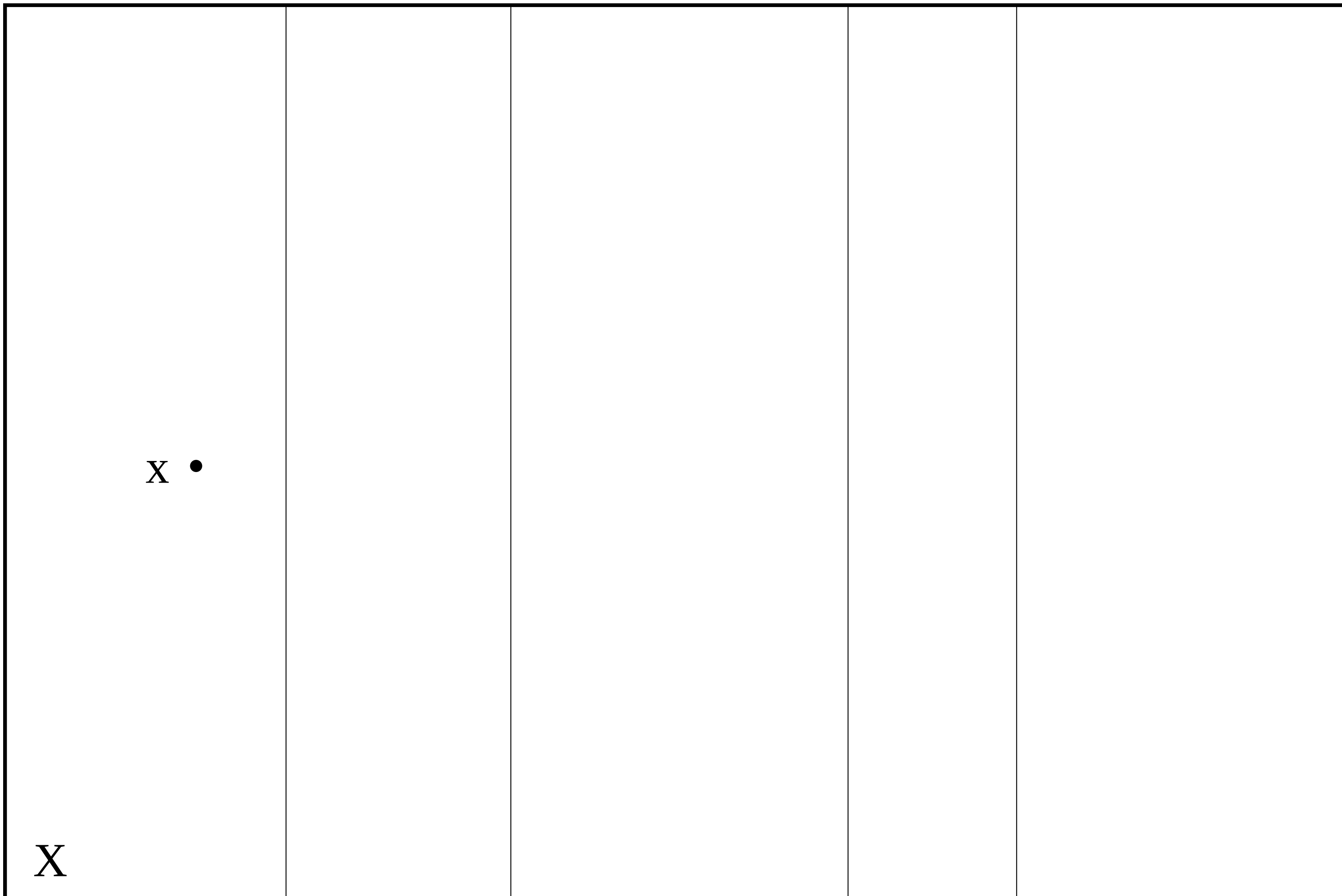
Dynamics: time evolution



Dynamics: time evolution



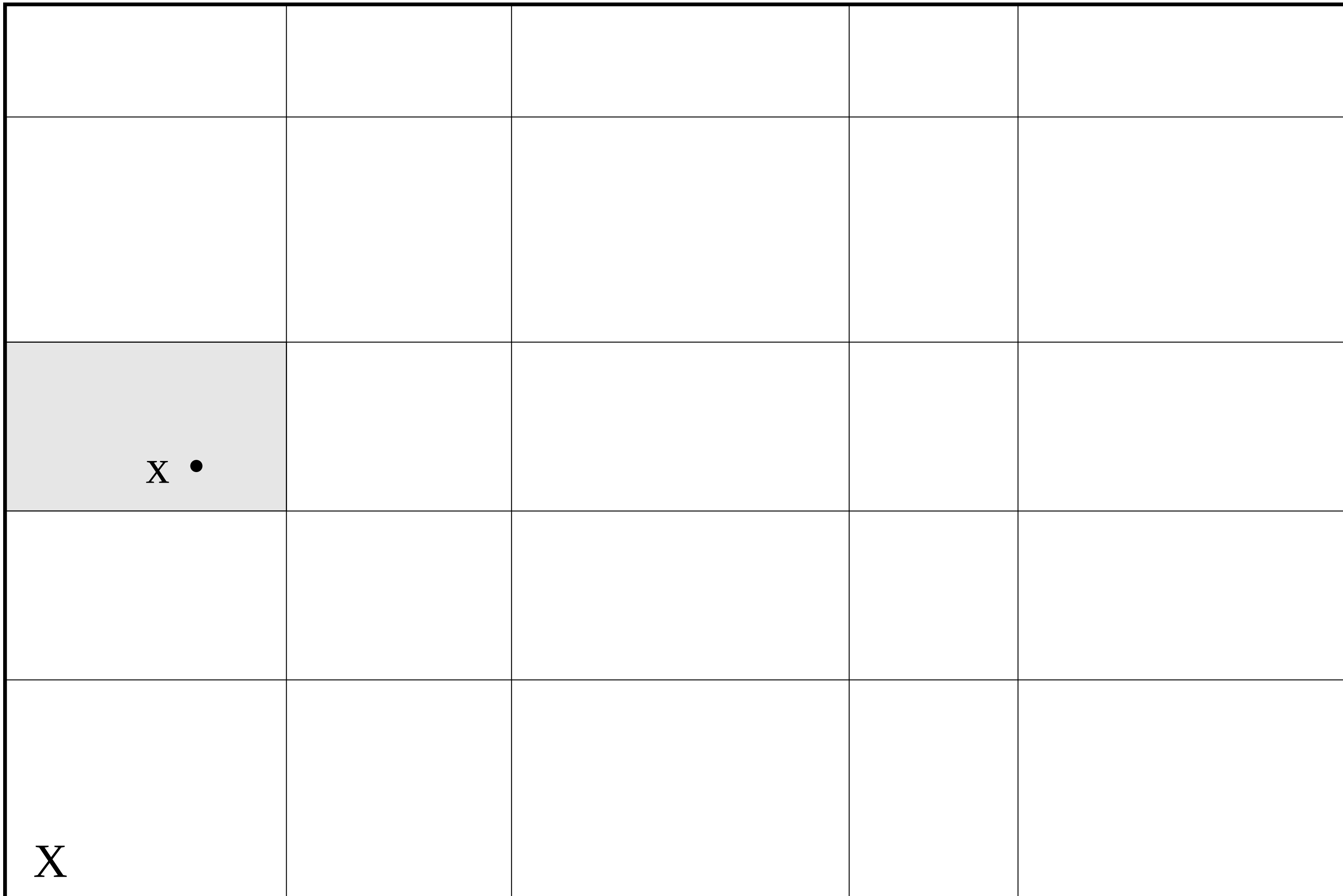
Natural linguistic descriptions



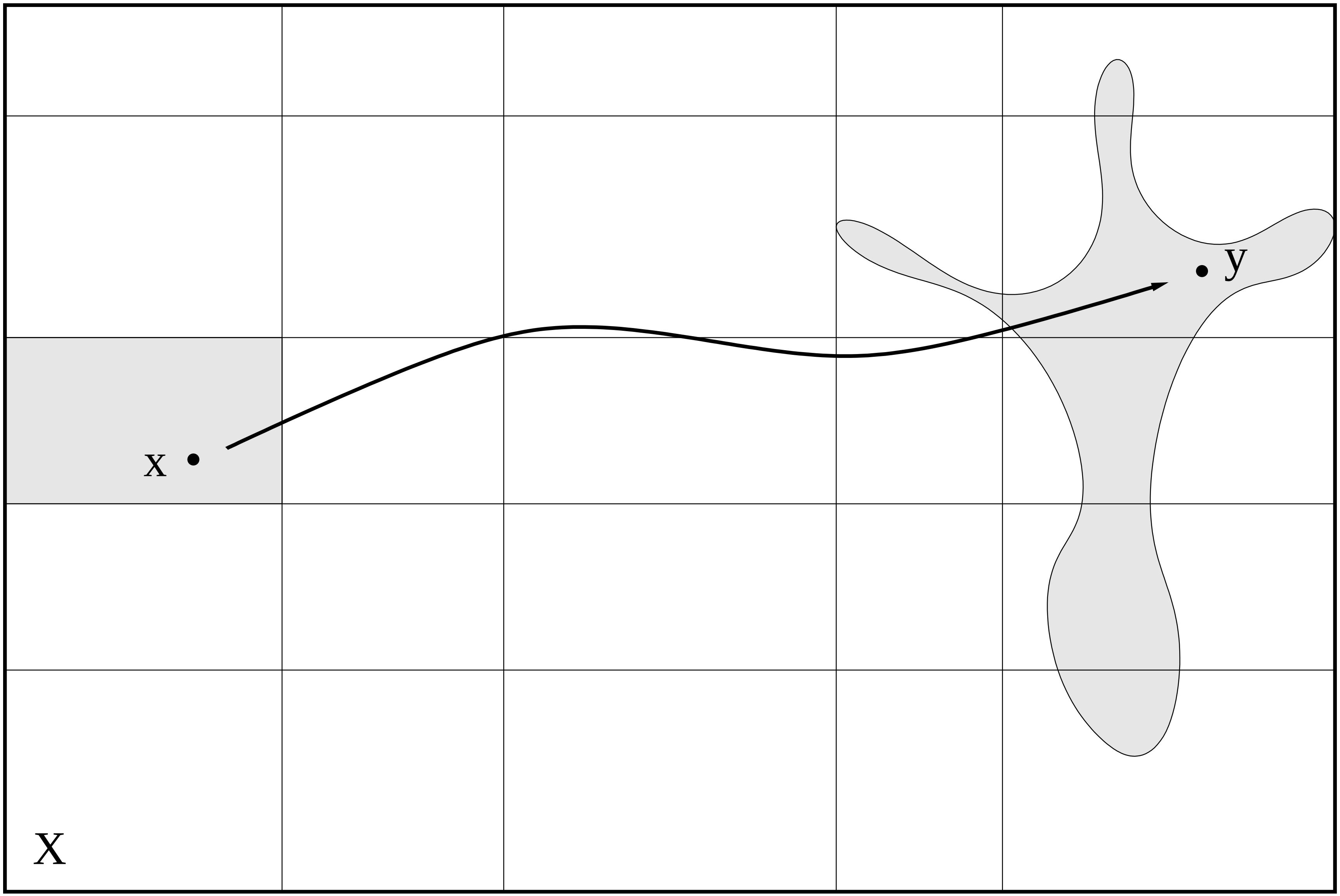
Natural linguistic descriptions

x •				
X				

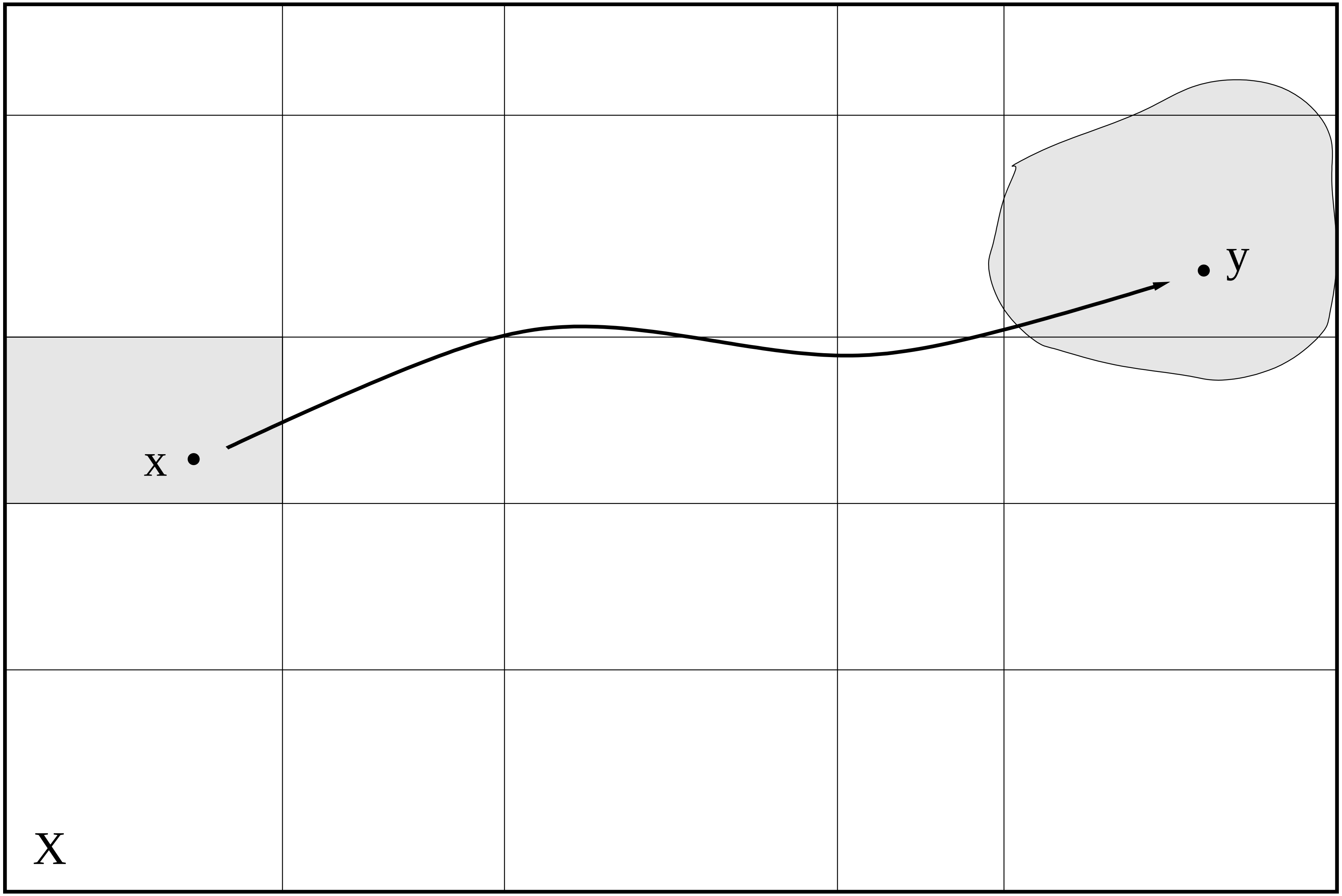
Descriptive states



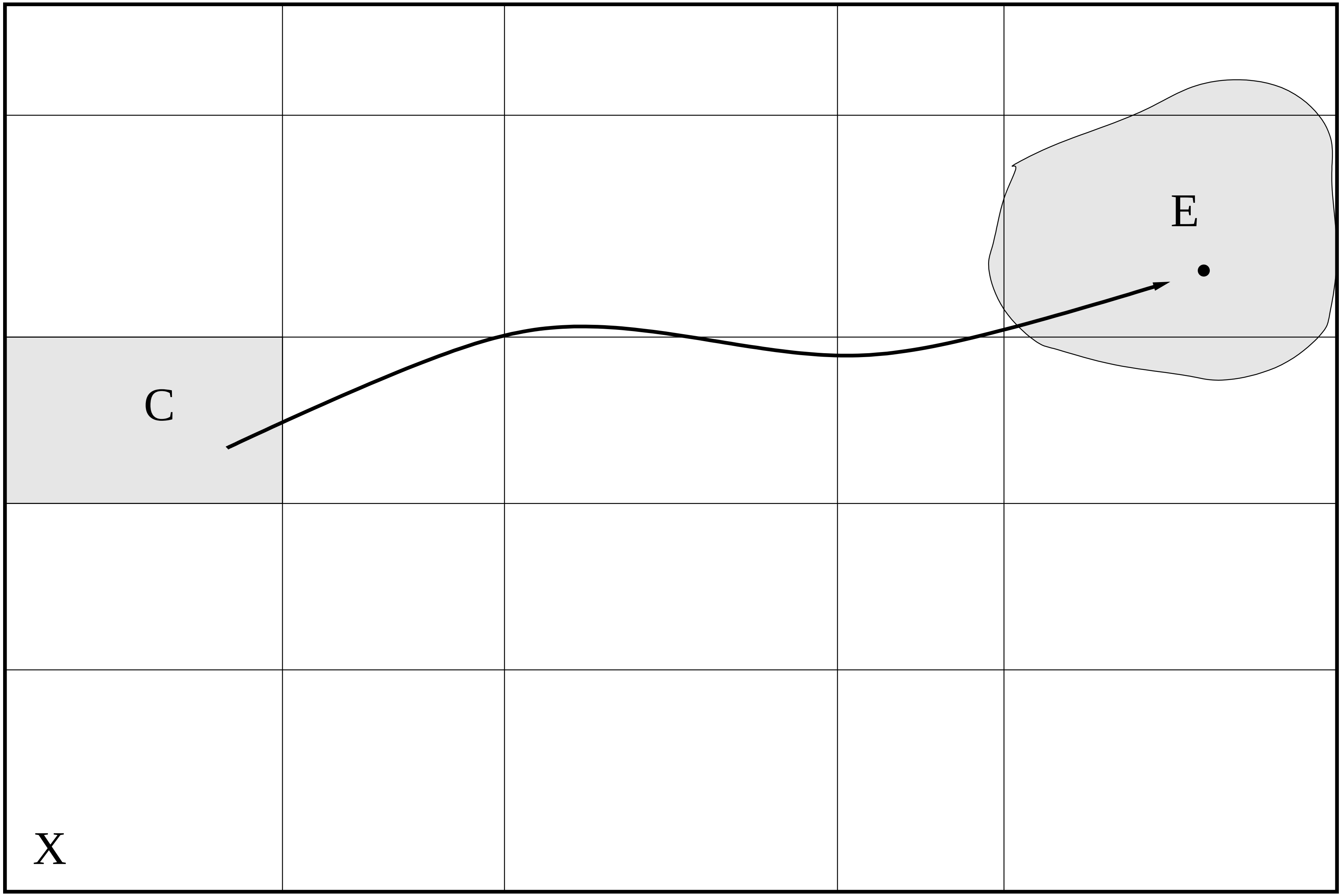
Descriptive states



Descriptive states



Cause and effect states



Causation

Dynamical systems approach:

- **State space:** set of possible states of the system
- **Dynamics:** time evolution
- **Descriptive state:** induced by our natural linguistic descriptions carving up the state space
- **Probability:** relative frequency of the various physical states

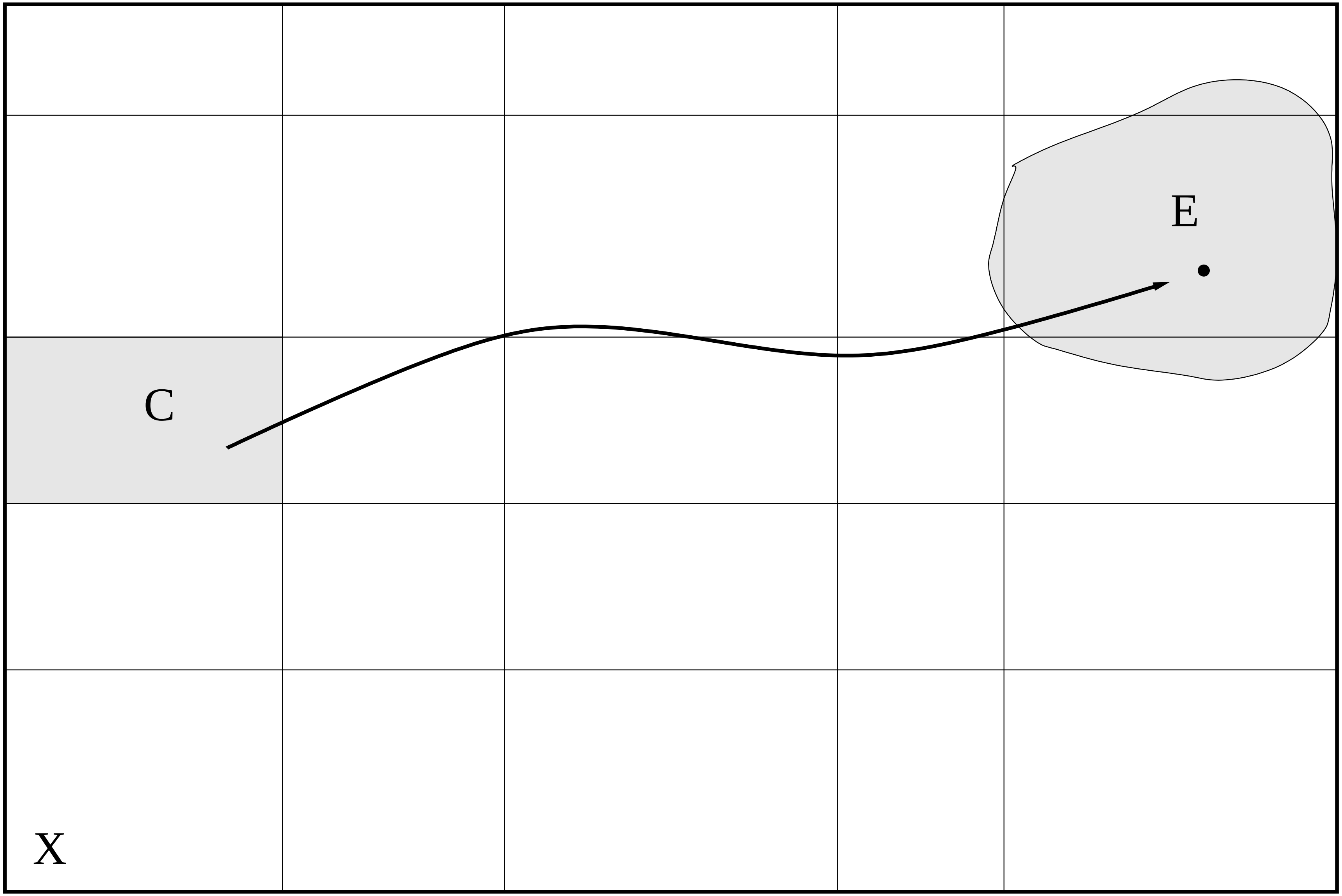
Causality emerges from a systematic channeling of descriptive states under the underlying dynamics

A causal claim is true if the majority of physical states in the cause region evolve with time into the effect region

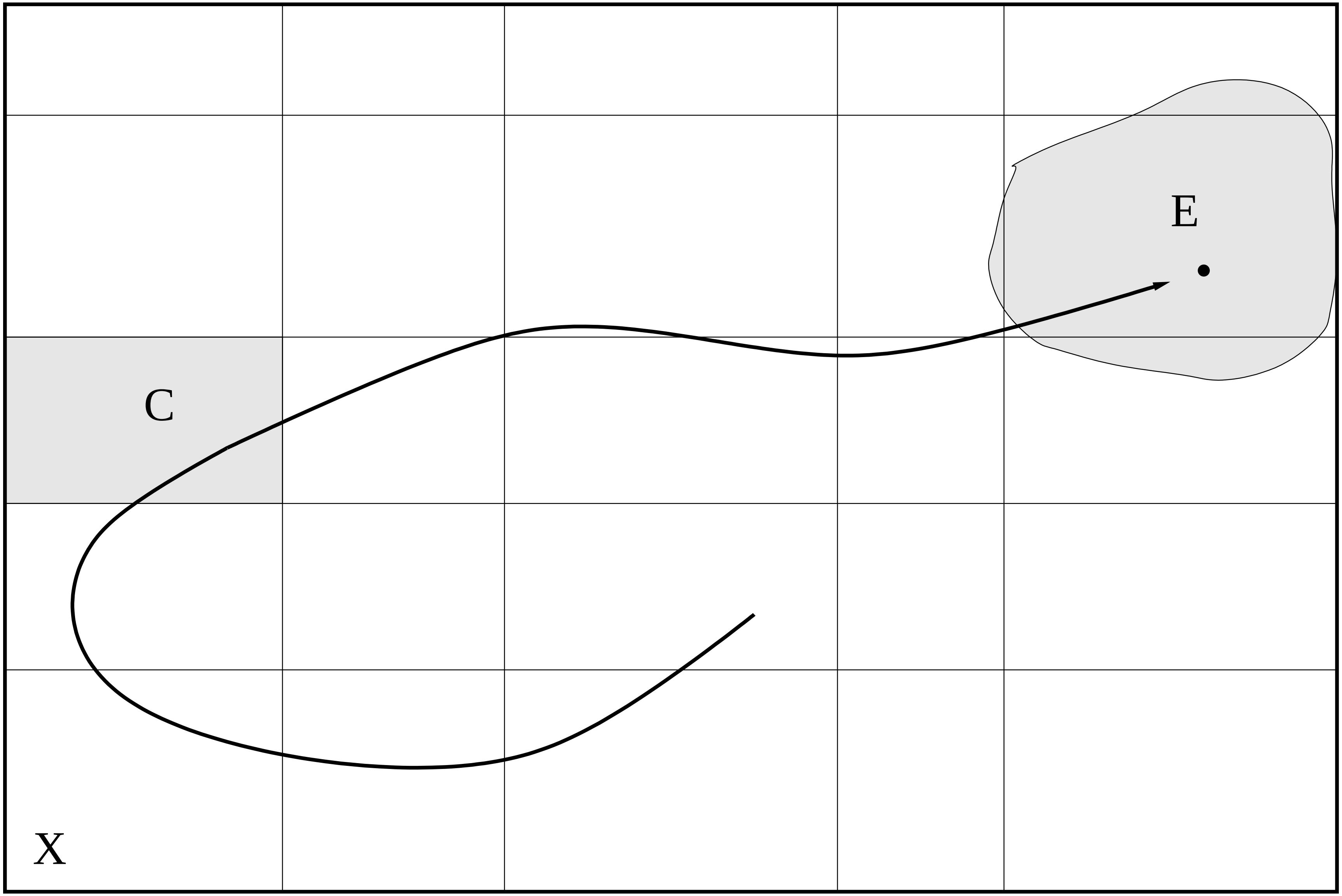
Fine prints

- characteristic time
- majority
- accuracy $\longrightarrow$ late preemption

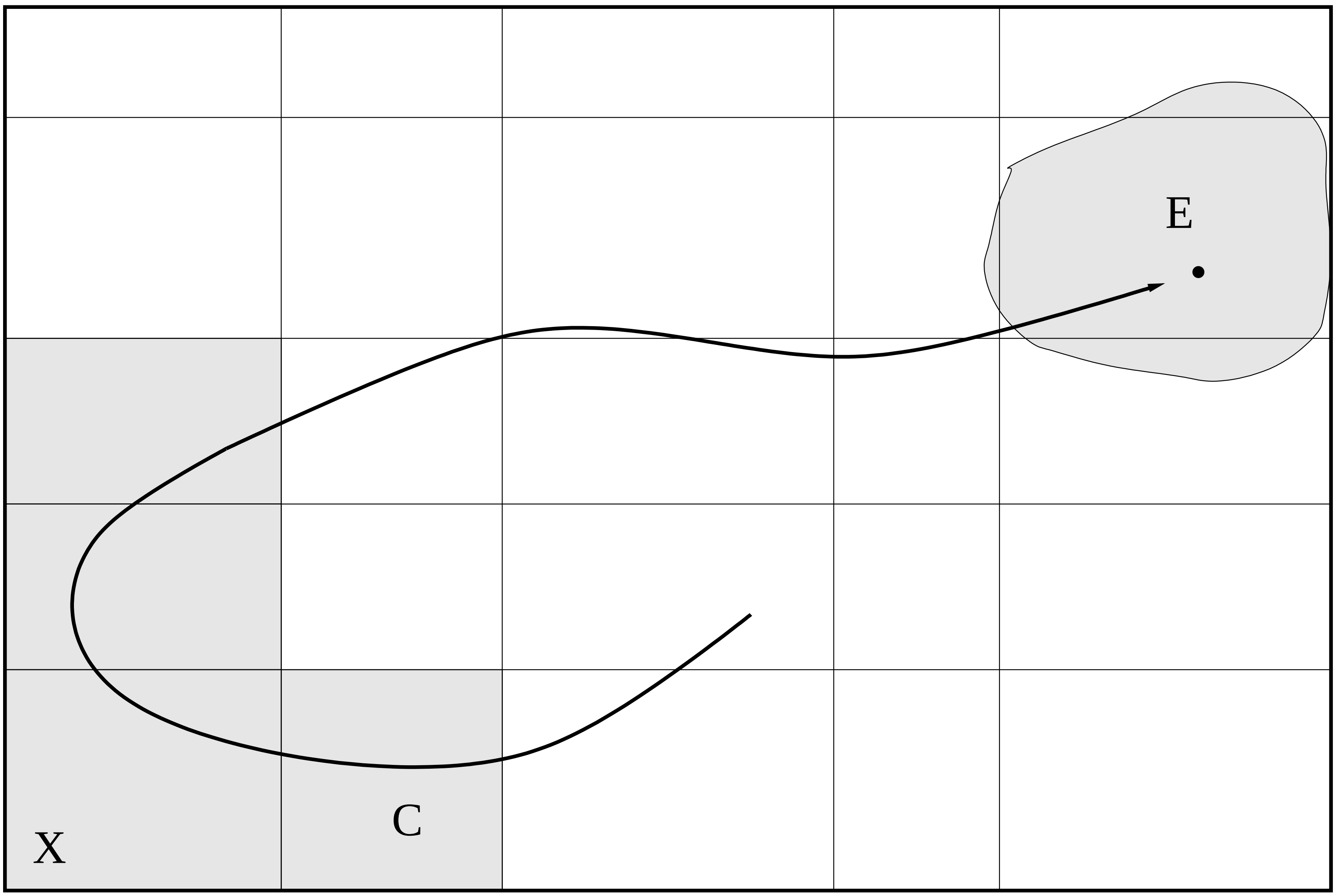
Projective states



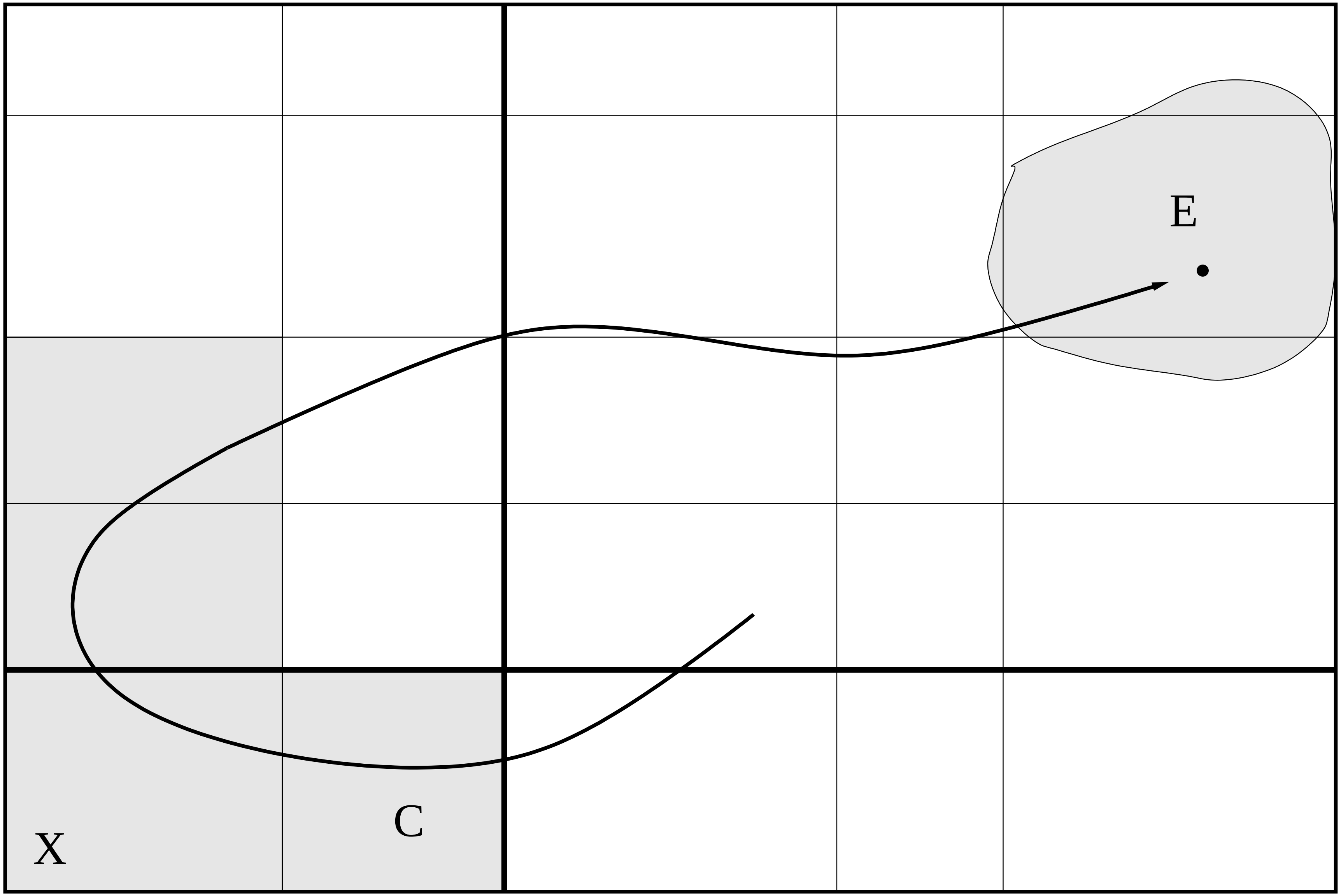
Projective states



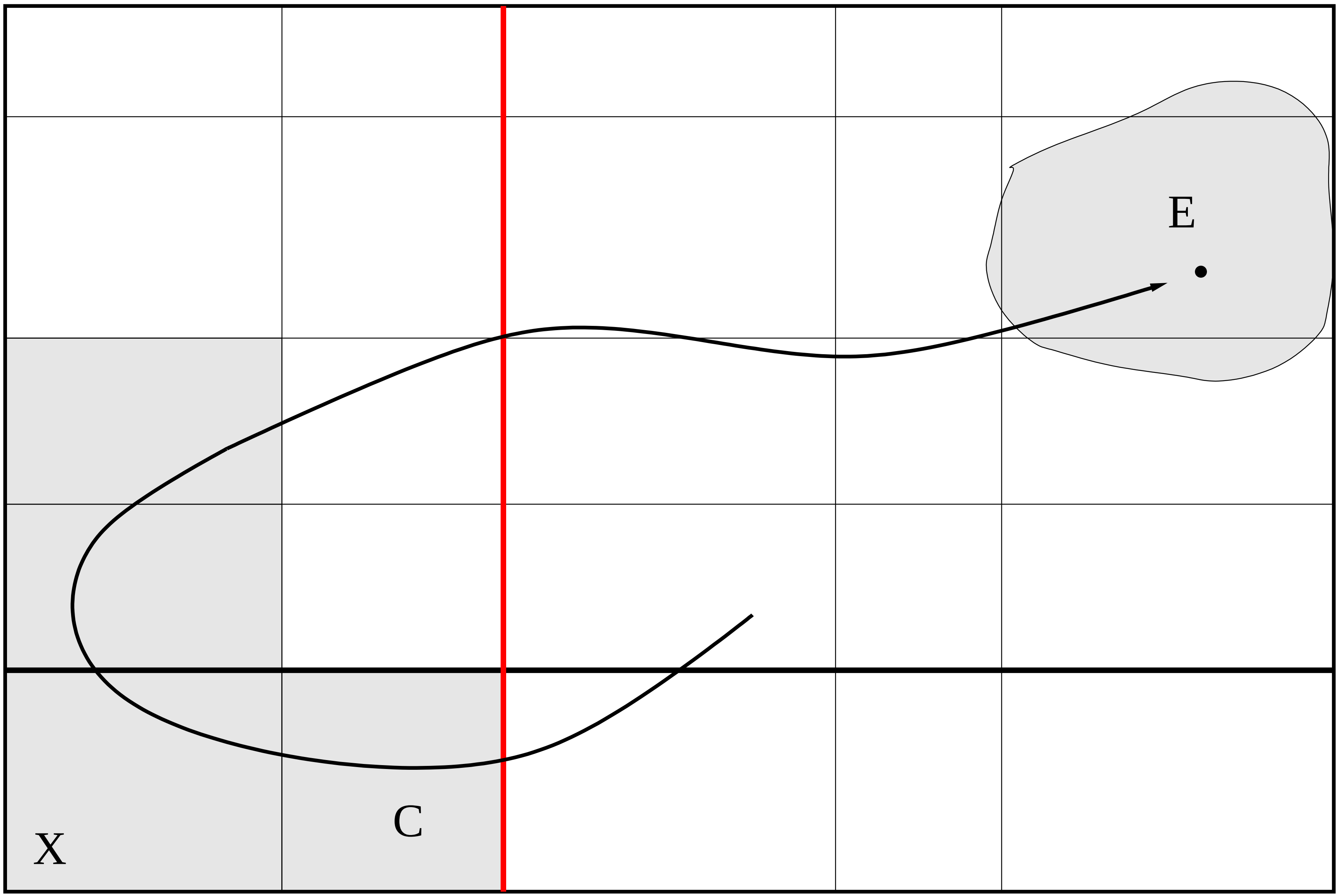
Principal projective state



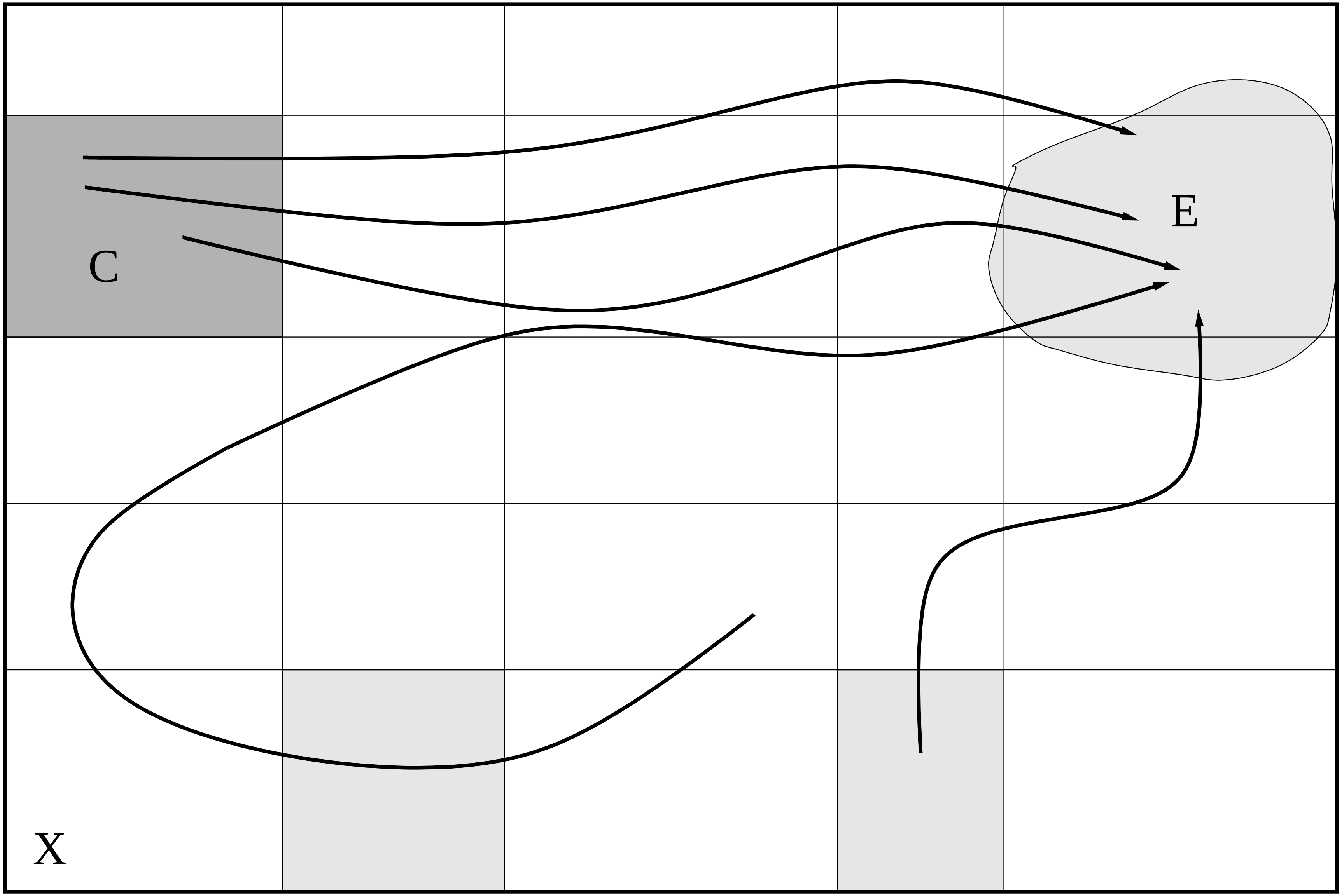
Causally relevant factors



The cause: the last straw



Typical cause



Causation

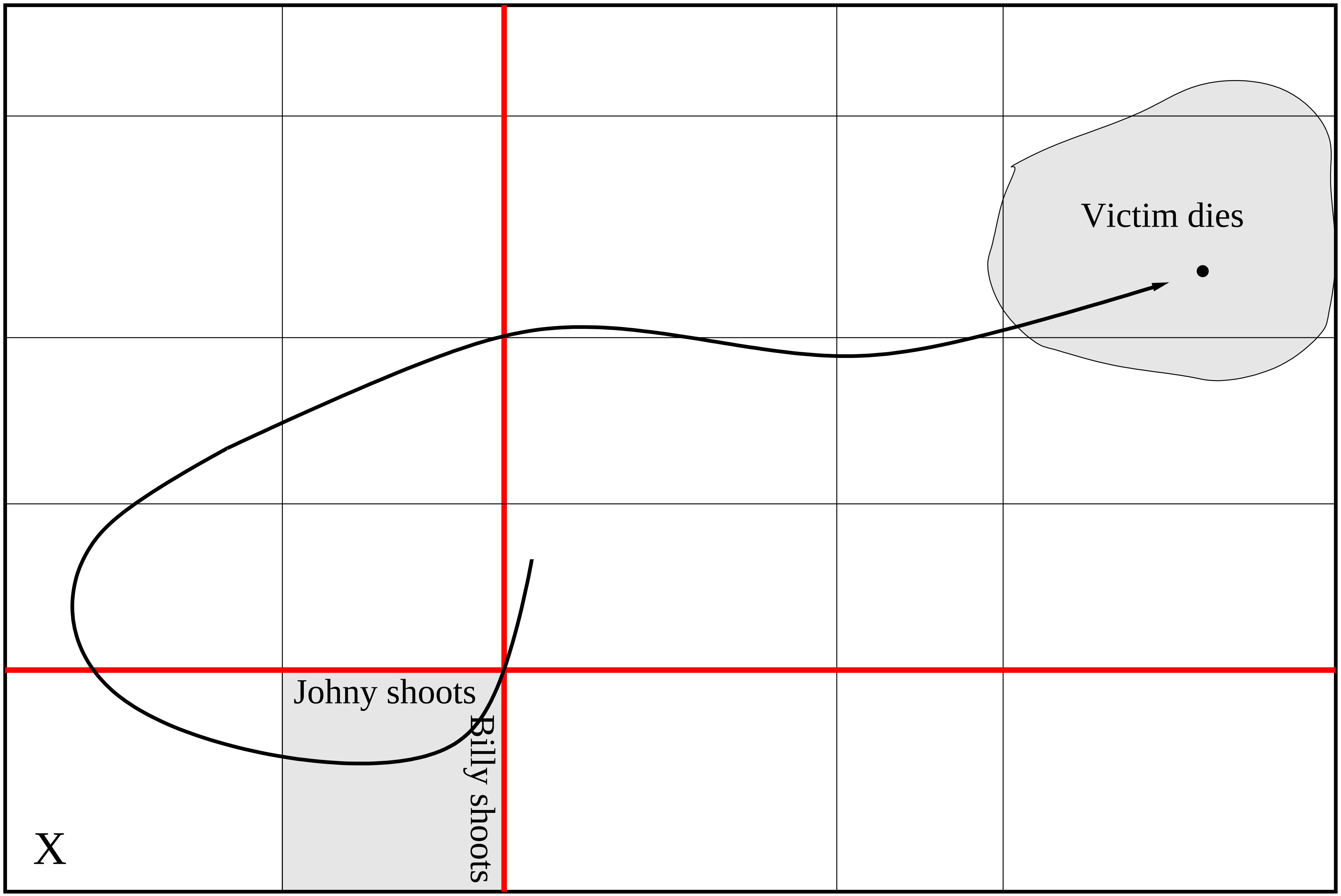
Terminology:

- **Projective states:** descriptive states from which the dynamics sends the majority of physical states into the effect state
- **Principal projective state:** the first projective state
- **Causally relevant factors:** properties demarcating a projective state from the neighboring non-projective states
- ***The* cause:** that causally relevant factor through which the trajectory enters the principal projective state
- **Typical cause:** that projective state which is crossed by the majority of the trajectories leading to the effect state

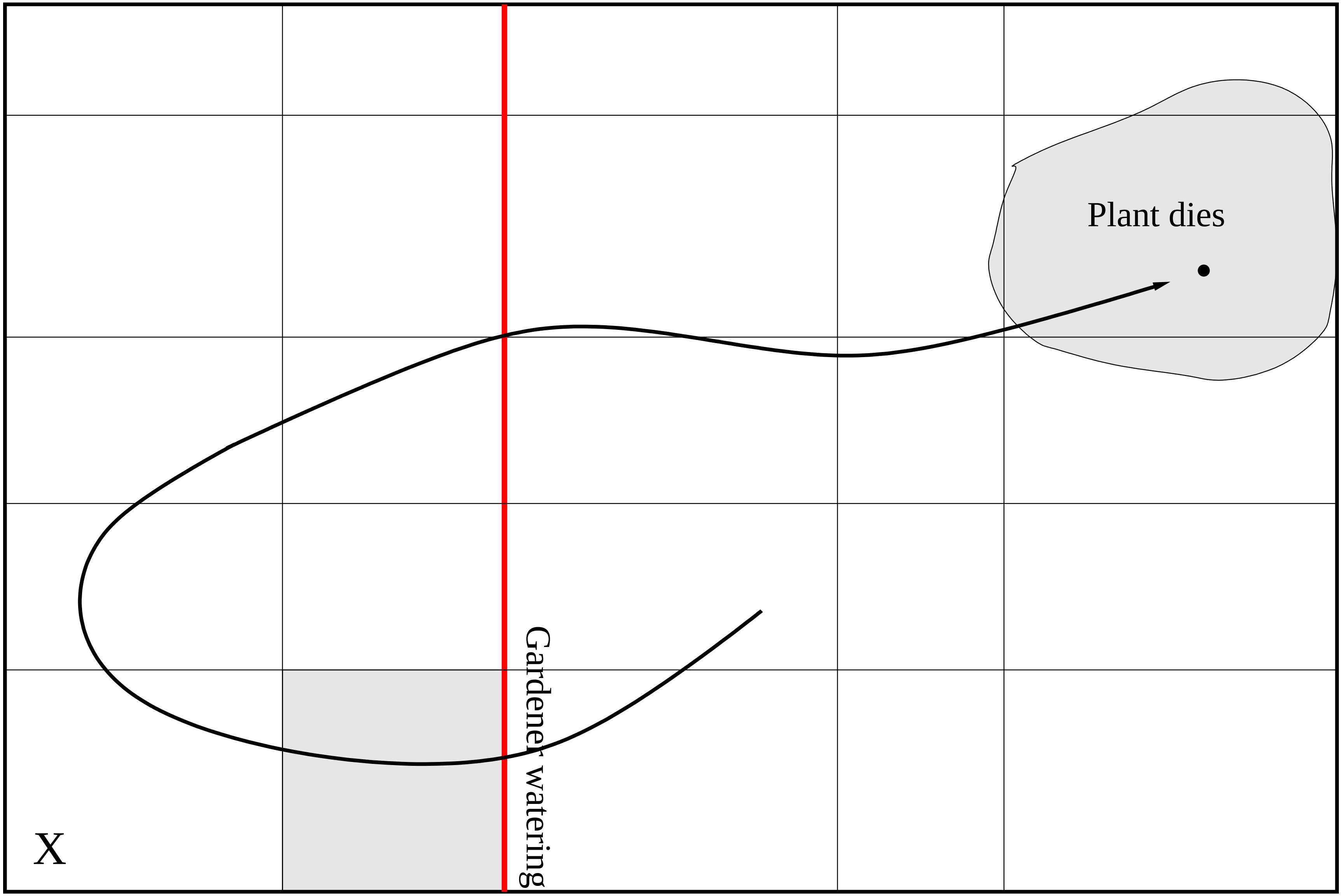
Applications

1. Symmetric overdetermination
2. Early preemption
3. Late preemption
4. Prevention
5. Omission

Symmetric overdetermination



Omission



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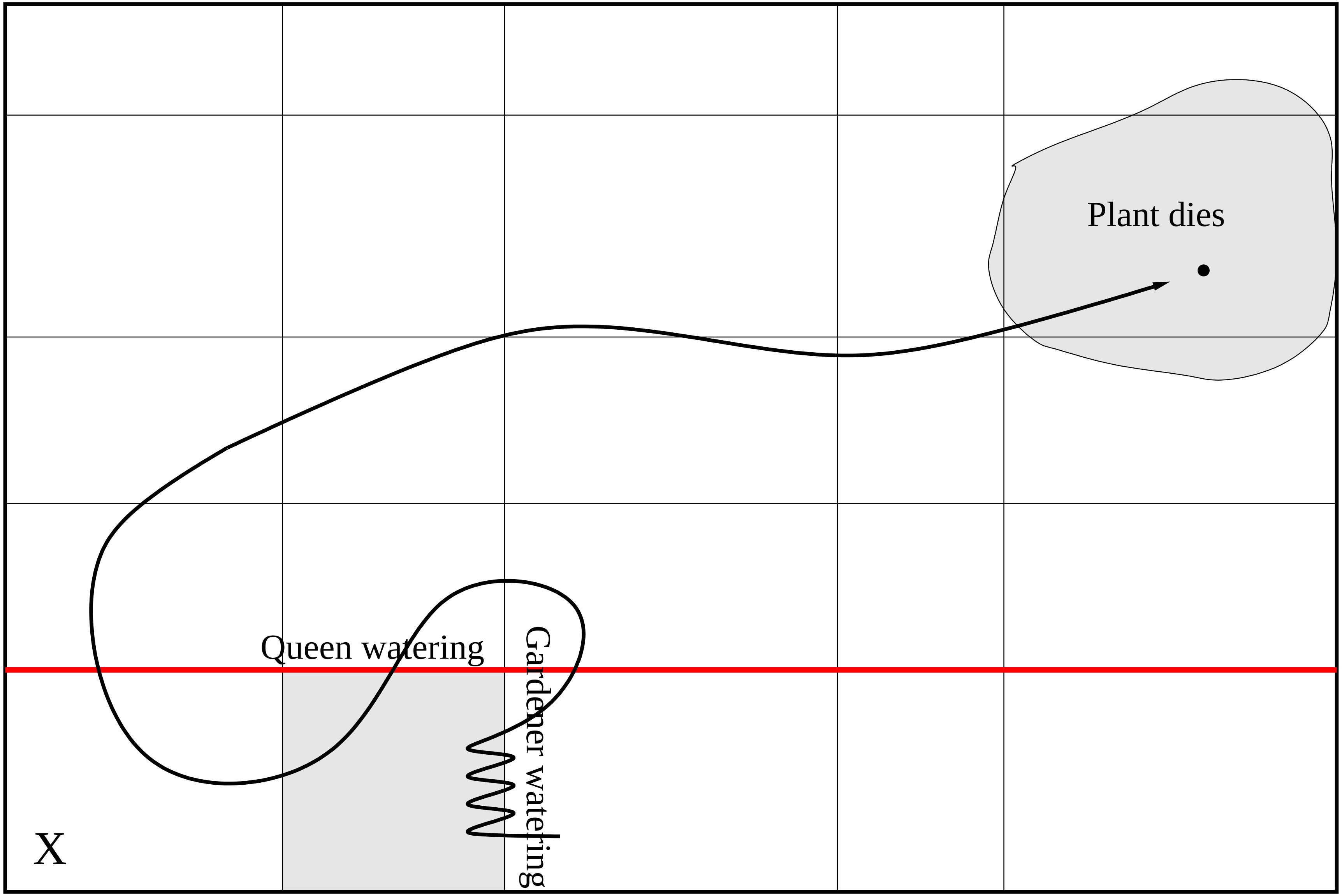
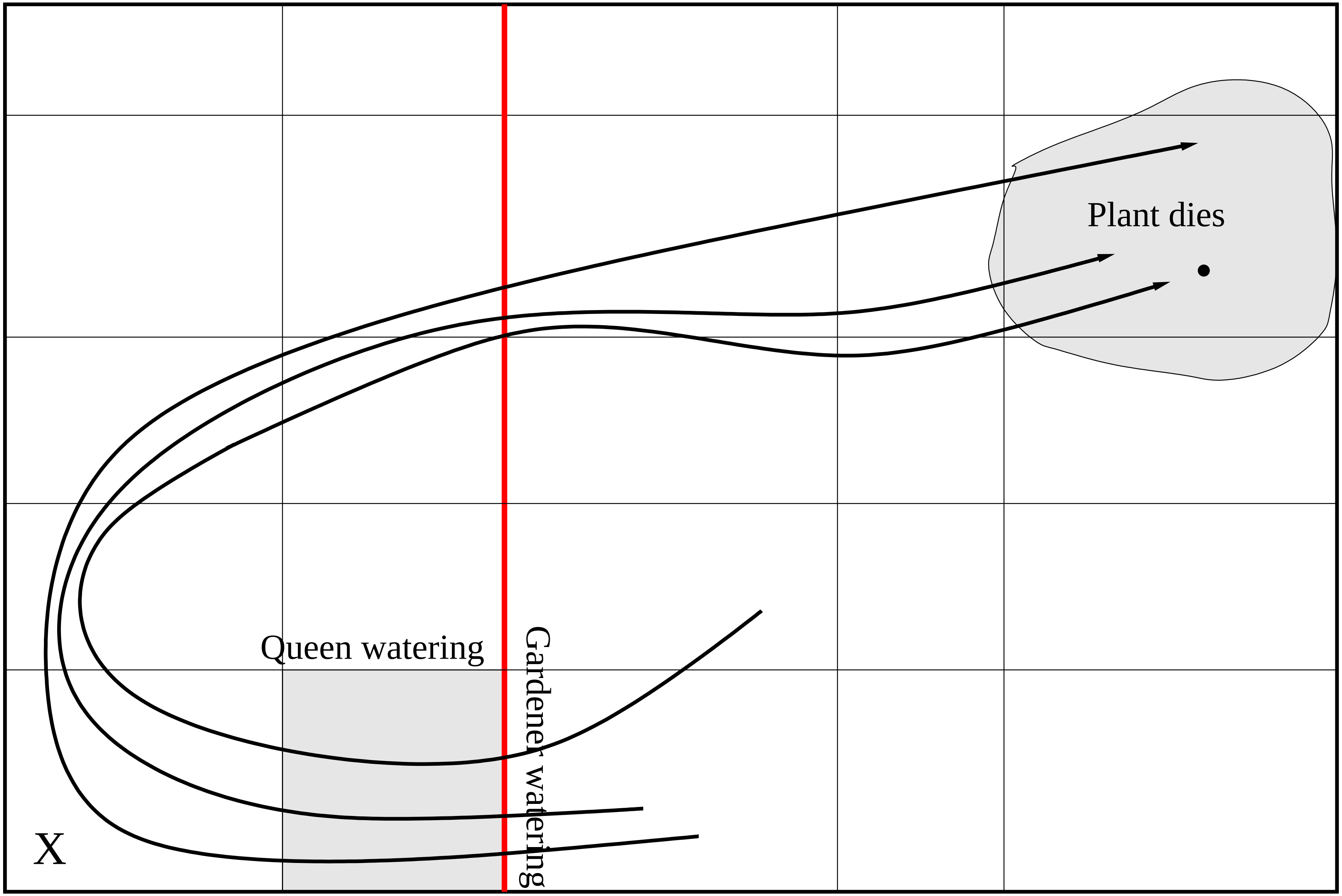


Omission



Conclusions

The dynamical systems approach to causation

- provides an empirical truth condition for causal claims;
- integrates the conceptual and empirical analyses of causation in a single framework;
- accounts for the main challenges of the conceptual analysis;
- has many possible fields of application such as physicalism, mental causation, etc.