LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

MODEL AGENTS: SOCIAL BEHAVIOR THROUGH THE FORMAL LENS

WHY MODEL?

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What’s in a model?

PAUL E. SMALDINO

Reality is complicated.

So it’s useful to work with simplified versions of it.

Smaldino, P. (2023). *Modeling Social Behavior. Mathematical and Agent-Based Models of Social Dynamics and Cultural Evolution*. Princeton University Press.

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GEORGE BOX

All models are wrong, but some are useful.

Ok, but is this *science*?

JOHN VON NEUMANN

... the sciences do not try to explain, they hardly even try to interpret, they mainly make models.

By a model is meant a mathematical construct which, with the addition of certain verbal interpretations, describes observed phenomena.

The justification of such a mathematical construct is solely and precisely that it is expected to work —that is, correctly to describe phenomena from a reasonably wide area.

von Neumann, J. (1995). Method in the physical sciences. In *The Unity of Knowledge*, edited by L. Leary (1955), pp. 157-164.

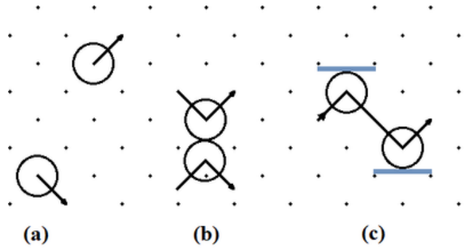
Ok, but is this *science*?

DIFFERENT MODELS

PHYSICS

Billiard-ball model of a gas.

Bohr model of an atom.



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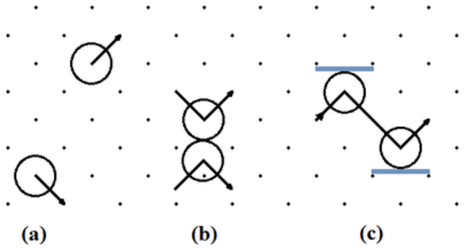
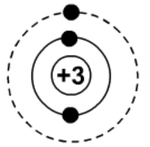
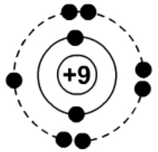
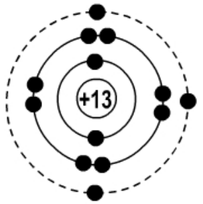




Lithium



Fluorine



Aluminum

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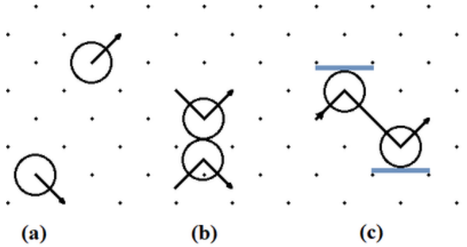

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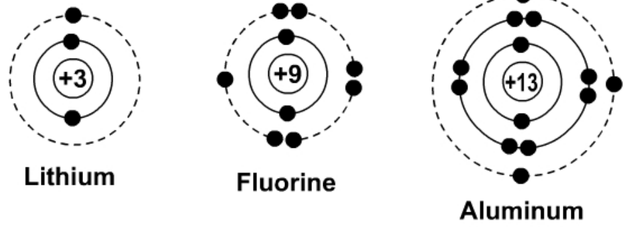
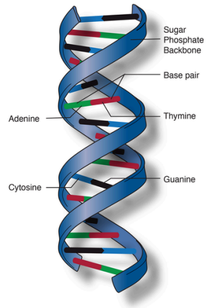


BIOLOGY

Double-helix model of DNA.



Lotka-Volterra model of predator-prey dynamics.

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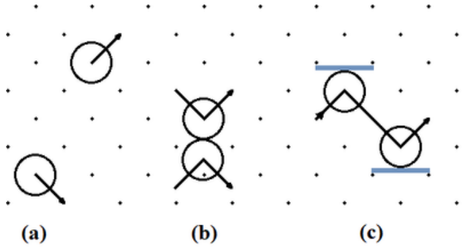

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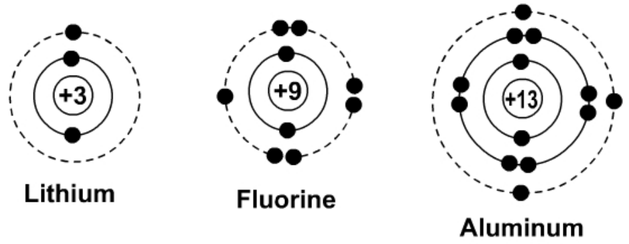

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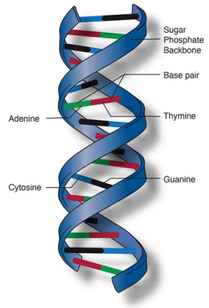

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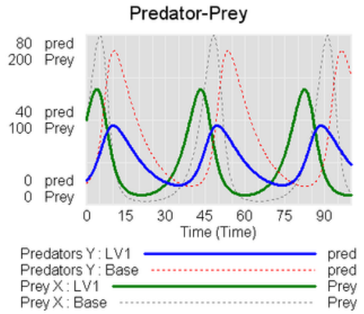

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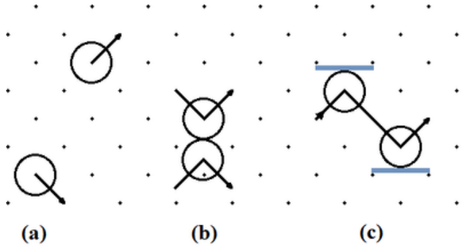

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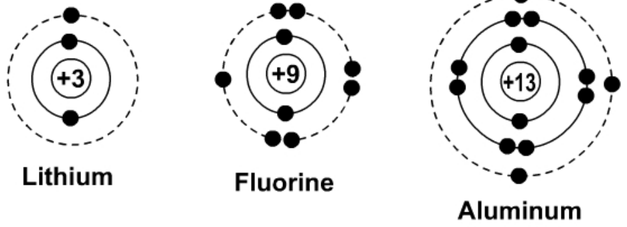

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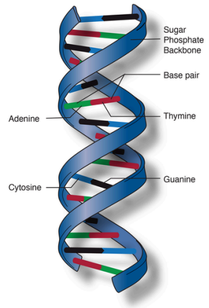

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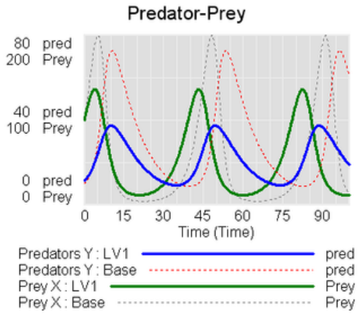


SOCIAL SCIENCES

Game-theoretic models.

In game-theoretic models, we assume agents are rational and converge towards certain equilibria.

JOSHUA M. EPSTEIN

But the rational actor—a perfectly informed individual with infinite computing capacity who maximizes a fixed (nonevolving) exogenous utility function—bears little relation to a human being.

In plain words, people aren't always rational.

ROBERT AXTELL

Game theory [...] has been preoccupied with static equilibria, and has essentially ignored time dynamics.

JOSHUA M. EPSTEIN

This means existing approaches miss important social phenomena: *complex phenomena*.

ROBERT AXTELL

That is, that emerge at the macro-level from local interactions.

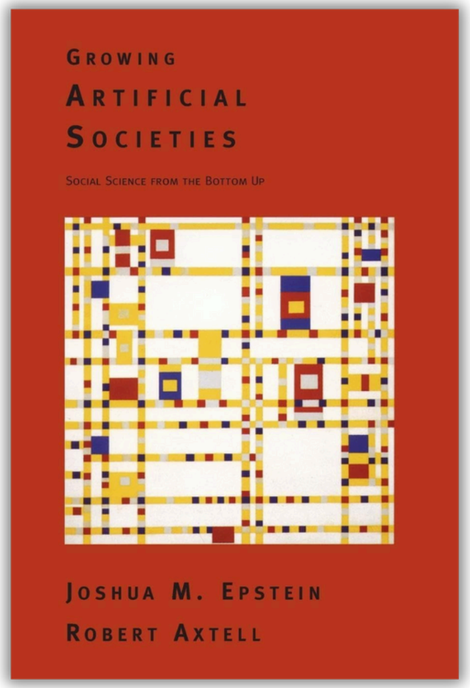
Enter agent-based models.

JOSHUA M. EPSTEIN

What constitutes an explanation of an observed social phenomenon? Perhaps one day people will interpret the question, "Can you explain it?" as asking "Can you grow it?"

ROBERT AXTELL

Agent-Based Models (ABMs) allow us to “grow” such structures in silico.



Growing Artificial Societies: Social Science from the Bottom Up

JOSHUA M. EPSTEIN & ROBERT L. AXTELL

The MIT Press
1996

Enter NetLogo.

URI WILENSKI

NetLogo is an open source programming language for agent-based modelling.

Created in 1999, in the spirit of the Logo programming language.

Low threshold, high ceiling.

Used to simulate natural and social phenomena.

Easy to install and has an extensive library of models, including ones that we will study.

NetLogo Home Page (northwestern.edu).