

CDS 270-3

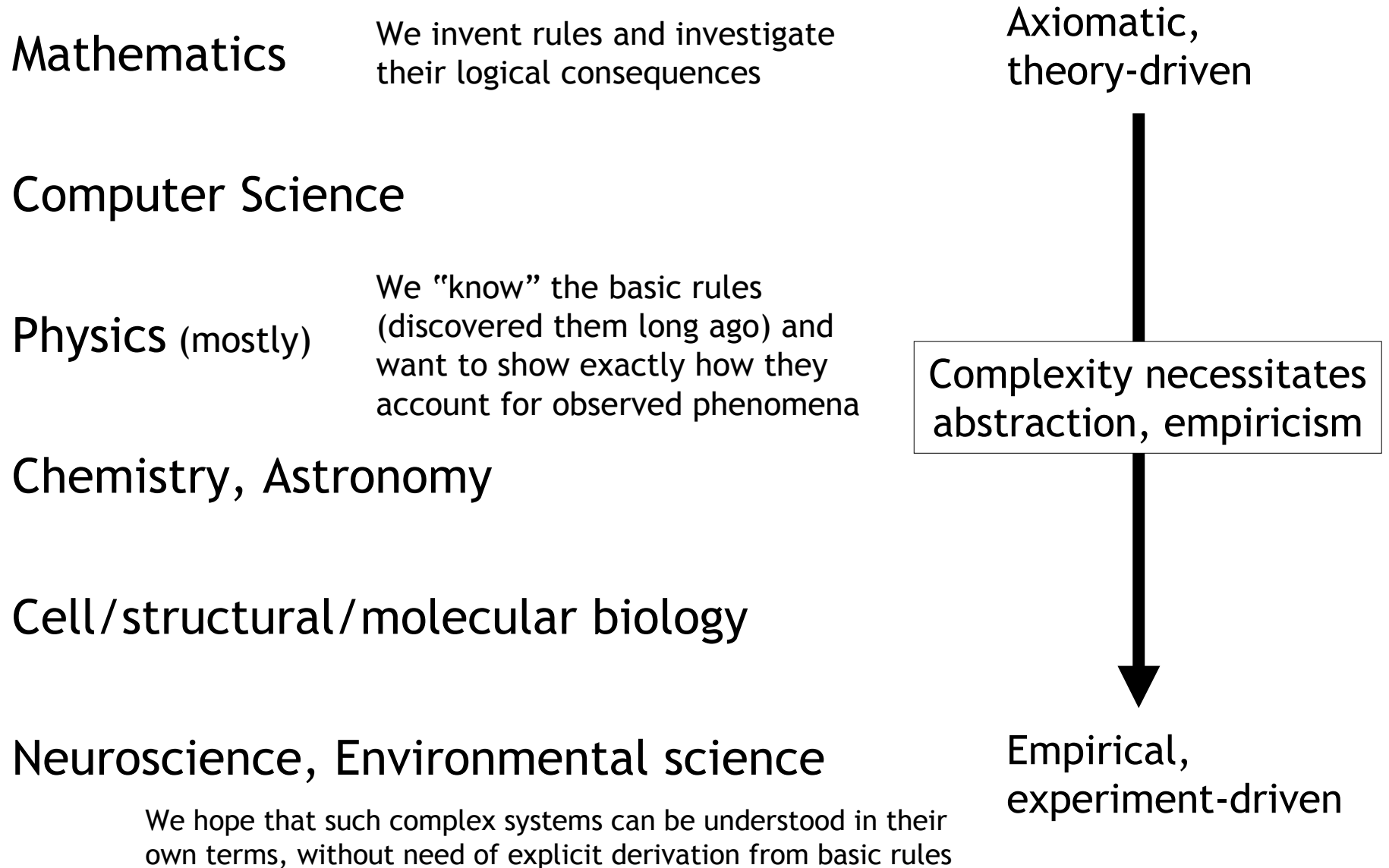
Frontiers in control / Science and control theory

Richard Murray, Hideo Mabuchi, and the Caltech community

- The axiomatic spectrum of sciences
- Concepts and methods from control theory
- The role of theory in empirical science
- Future directions in Control and Dynamical Systems

www.cds.caltech.edu/~murray/courses/cds270-3

The axiomatic spectrum of sciences



Engineering methodology

- synthesis: building systems from parts
 - identification: inferring quantitative models from data
 - validation: designing experiments to test models
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- empirical science
 - multiscale science

The role of theory in empirical science

Traditionally, empirical scientists have used theory to:

- work out the logical consequences of hypotheses
- avoid jumping to conclusions
- design strict tests of a quantitative model
- design experiments that focus on a single hypothesis

We hope that CDS theory can also be used to provide new modes for understanding “why” certain natural complex systems have the structures that they do:

- robustness - necessary for life, appears in multiscale picture
- evolvability - necessary for adaptability in life, technology

we want this class to consider all these things

Multiscale science

Mathematics

Computer Science

Physics (mostly)

molecular physics, stat mech

Chemistry, Astronomy

biochemistry

Cell/structural/molecular biology

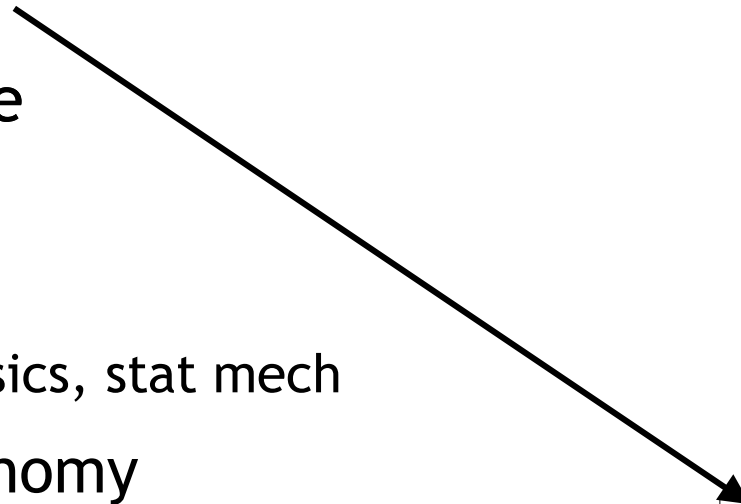
geobiology

Neuroscience, Environmental science

microscopic

model reduction

macroscopic



Course philosophy and logistics

- “subject” presentations by science and engineering faculty
- form *interdisciplinary* teams of course participants
- “proposal” presentations at end of term
- theory and modeling discussion sessions?

Proposals: teams consisting of CDS students plus scientists and/or engineers should formulate a research plan for how CDS-type theory can be applied in subject areas covered by the faculty presentations. Specific theorems/methods should be related to specific questions of scientific or engineering interest.