

COMPUTER SIMULATIONS AND SIMULACRA

It is astonishing, yet one of the greatest human breakthroughs, that we can come up with metaphors for nature in the form of scientific theories. This is most evident when we understand physics so well that our video games have become eerily like our real-life experiences. Moreover, computational scientists have started using the term “digital twin” for their computer models of real systems. Such corroboration motivates for exploration of what it means to simulate a process. There lie epistemological questions in this space, including but not limited to inductive reasoning of simulation, the continuous vs. discrete nature of space, the physical computing of nature, and finally, whether or not we are living in a simulation. The students will explore both the philosophical concepts (Descartes, Searle, Plato, Judea Pearl) and a diverse set of simulations (molecular dynamics, fluid dynamics, mechanics, and predictive modeling), tying it together for a unifying understanding of our increasingly simulated worlds.

Syllabus

Philosophy of Simulations and Modeling

- Turing, “*The Imitation Game*”
- Excerpts from Hume *A Treatise of Human Nature*
- Inductive Reasoning and Causality – Judea Pearl
- Phenomenology - Merleau-Ponty and Buddhist texts.
- Eric Winsberg, *The Epistemology of Simulation*

History and Development of Computer Simulations

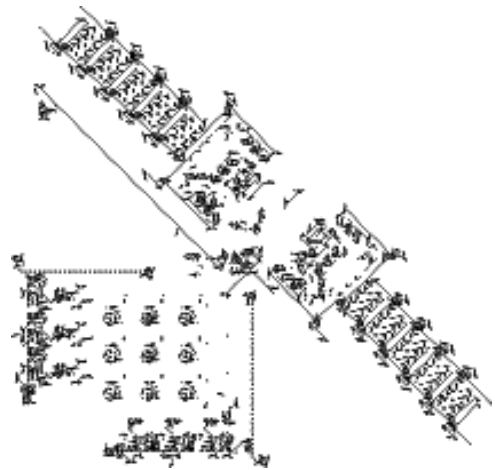
- Simulation vs. Theory vs. Experiment
- Early Simulations: Human Calculators and MANIAC
- Modern Simulations: scales, speeds, and scope
- When is a simulation useful? Are simulations explanations?

Types of Simulation

- Time-evolution dynamics: atoms, fluids, galaxies
- Frequency-space modelling: vibrations and natural modes
- Monte Carlo methods
- Black-box models

Simulacra, Emergence, and Epistemology

- The Truman Show (screening)
- Thought Experiments: Plato, “The Allegory of the Cave”; Descartes, “Meditations I-III”; Searle, “Chinese Room Puzzle”; Harman, Brain in the Vat.
- Conway’s Game of Life
- The Matrix (screening)
- Jean Baudillard, “*Simulacra and Simulation*”



A Turing machine encoded within Conway's Game of Life,
https://conwaylife.com/wiki/Turing_machine