MODELS and SIMULATIONS

WiSe 2019/20   Tues. 12 (c.t.) – 14h   HG / 1.072

Instructor: Dr. Catherine Stinson

This is a philosophy of science seminar covering the use of models in science, with a focus on computational models. We will cover how models differ from theories and experiments, varieties of model explanations, similarity and idealization in modeling, how scientists draw inferences from models, the metaphysics of models, and when to trust models in decision-making. Examples will include economic modeling, model organisms in biology, mathematical models in physics, climate simulations, AI models, and computational psychiatry.

Presentations:
Students will give 2 presentations during the semester.
Model Presentation: Choose a scientific model from any branch of science. (Some possible options: Edgeworth box, Lotka-Volterra, transgenic mice, global climate models, Large Hadron Collider, neural networks). Research the model, and give a 10 minute presentation about it, ideally with visual aids. Topics to cover: how it works, what it models, and how scientists learn from it. Be prepared to lead a brief discussion about how the model illustrates themes from the course.
Paper Presentation: Give a 15 minute work-in-progress report about your final paper. Motivate the topic and sketch out your arguments. Be prepared to lead a brief discussion.

Final Papers:
Final papers can be written on any philosophical topic closely related to the course material. Students should discuss their paper with the instructor in office hours at least once before their work-in-progress presentation, and again before writing the final draft.

Accessibility:
If the course delivery, readings, or assignments aren't working for you because of linguistic, disability, health, financial or other barriers, please do consult with the instructor. Reasonable accommodations will be made wherever possible.

Texts:
Morgan (2012) *The World in the Model*
Potochnik (2017) *Idealization and the Aims of Science*
Weisberg (2013) *Simulation and Similarity*

Schedule of Topics and Readings:

October 8	What is a Model?	Optional Reading: **Weisberg** ch. 1,2
October 15	Models vs. Theories	**Teller** (2001) "Twilight of the Perfect Model Model" **Morgan & Morrison** (1999) *Models as Mediators*, ch. 1,2 Additional Reading: **Hempel & Oppenheim** (1948) "Studies in the Logic of Explanation" **Cartwright** (1983) *How the Laws of Physics Lie*, (1999) *The Dappled World* **Potochnik** pp. 23-41
October 22	Mathematical Models	**Lange** (2013) "What Makes a Scientific Explanation Distinctively Mathematical?" **Pincock** (2014) "Abstract Explanations in Science" Additional Reading: **Huneman** (2010) "Topological Explanations and Robustness in Biological Sciences"
October 29	Models in Evolutionary Biology	**Levins** (1966) "The Strategy of Model Building in Population Biology" **Quinn** (under review) "Concatalypse Now: Competing methods and paradigms in phylogenetics"
November 5	Material Models	**Morgan** ch. 5,7
November 12	Model Organisms	**Weber** (2009) ch. 6 "Model Organisms: Of Flies ad Elephants" **Ankeny & Leonelli** (2011) "What's so special about model organisms?"
November 19	Simulations	**Parker** (2009) "Does matter really matter? Computer simulations, experiments, and materiality" **Morgan** ch. 8 Additional Reading: **Lloyd** (2015) "Model Robustness as a Confirmatory Virtue: The Case of Climate Science" **Norton & Suppe** (2001) "Why atmospheric modeling is good science" **Humphreys** (2009) "The Philosophical Novelty of Computer Simulation Methods"
November 26	Similarity	**Weisberg** ch. 8 **Godfrey-Smith** (2009) "Models and Fictions in Science" Additional Reading: **Frigg & Nguyen** (2018) "The turn of the valve: representing with material models"
December 3	Beyond Representation	**Knuuttila & Boon** (2011) "How do models give us knowledge? The case of Carnot's ideal heat engine" **Grüne-Yanoff** (2013) "Appraising Models Nonrepresentationally"
December 10	Idealization	**Weisberg** ch. 6 **Potochnik** pp. 41-61

		Additional Reading: **Wimsatt** (1981) "Robustness, Reliability, and Overdetermination" **McMullin** (1985) "Galilean Idealization"
December 17	False Models	**Mäki** (2011) "The Truth of False Idealizations in Modeling" **Batterman & Rice** (2014) "Minimal Model Explanations" Additional Reading: **Batterman** (2002) "Asymptotics and the role of minimal models" **Toon** (2010) "The ontology of theoretical modelling: models as make-believe"
January 7	Neural Models	**Chirimuuta** (2017) "Explanation in Computational Neuroscience: Causal and Non-causal" **Poldrack & Yarkoni** (2016) "From brain maps to cognitive ontologies: informatics and the search for mental structure" Additional Reading: **Irvine** (2014) "Model-Based Theorizing in Cognitive Neuroscience" **Ross** (2015) "Dynamical Models and Explanation in Neuroscience"
January 14	Artificial Intelligence Models	**Lake, Ullman, Tenenbaum & Gershman** (2017) "Building Machines that Learn and Think Like People" **Stinson** (forthcoming) "From Implausible Artificial Neurons to Idealized Cognitive Models: Rebooting Philosophy of Artificial Intelligence" Additional Reading: **Buckner** (2019) "Deep learning: A philosophical introduction" **Buckner** (2019) "Empiricism without Magic—Transformational Abstraction in Deep Convolutional Neural Networks"
January 21	Psychiatric Models	**Tabb** (2019) "Philosophy of psychiatry after diagnostic kinds" **Sullivan** (2017) "Coordinated pluralism as a means to facilitate integrative taxonomies of cognition" Additional Reading: **Stein** (2017) "Obsessive-compulsive and related disorders in DSM-5, ICD-11, and RDoC: Conceptual questions and practical solutions"
January 28	Complexity & Pluralism	**Morgan** ch. 10 **Potochnik** ch. 7 Additional Reading: **Mitchell** (2012) *Unsimple Truths* ch. 4,6 **Potochnik** ch. 6