



# Modeling the World's Systems

May 21–22, 2018 | Pittsburgh, PA

## Tutorials

### Agent Based Modeling: FRED

John Grefenstette, *Professor of Health Policy and Management, University of Pittsburgh*

Agent Based Models are computational simulations that enable researchers to create and experiment with artificial societies composed of agents that interact within an environment. FRED is a platform for simulating a large census-based artificial population within a specific geographic environment (e.g. a city, county or state). As an example, we will present a case study of how an air pollution emergency might affect the health systems in the City of Pittsburgh.

### Workflow Systems: OCCAM

Bruce Childers, *Associate Dean for Strategic Initiatives, School of Computing and Information, University of Pittsburgh*

This tutorial will explain how workflow systems can accelerate scientific discovery by improving the repeatability, collaboration, and reuse of data, models, and experiments. The typical structure and use of a workflow system will be presented. A demonstration of the OCCAM system will be given to illustrate just how easy it can be to specify and run experiments in a collaborative ecosystem built around modeling tools.

### Connecting Simulations with Human Experiments

Sera Linardi, *Associate Professor, Graduate School of Public and International Affairs, University of Pittsburgh*

This tutorial will begin with some workhorse game theoretic models (prisoner's dilemma, battle of the sexes, 2 person posterior revision process (Bayesian learning)) and how they are used to model the basic structure of many social interactions. Then it will discuss how humans play these simple games in the lab, and how these patterns of actual human behavior provide a source of empirical regularities that agent-based models in economics will then attempt to grow. We can also reverse the order and pre-generate prediction from various adaptive learning rules and then horserace them using specifically designed human subject experiments.

### Information, Quantum Mechanics, and the Universe

Jeremy Levy, *Distinguished Professor of Condensed Matter Physics; Director of the Pittsburgh Quantum Institute, University of Pittsburgh*

The Universe is the largest known quantum computer, calculating its own evolution in real time according to the laws of quantum mechanics. Here on earth, scientists and engineers have been trying to "tame" quantum mechanics for the purpose of computation. A sufficiently powerful quantum computer could defeat all known methods of secure communication over the internet. Quantum computation can also deliver radical speedup of important problems like database searching, optimization problems and materials design. Cutting-edge research in quantum computing is taking place at the University of Pittsburgh, which launched the Pittsburgh Quantum Institute back in 2012.

### Causal Modeling and Discovery

Greg Cooper, *Professor of Biomedical Informatics; Director of Center for Causal Discovery, University of Pittsburgh*

This tutorial will provide an introduction to concepts and methods for learning causal relationships in the form of causal networks from data, including solely observational data. Examples will be given of applying these methods to biomedical data. The talk will also provide pointers to software for learning causal networks from data, including data containing thousands of variables.

### The INDRA Architecture for Machine-Assisted Modeling

Benjamin Gyori, *Research Associate in Therapeutic Science, Laboratory of Systems Pharmacology, Harvard Medical School*

This tutorial will show two usage modes for INDRA: (1) natural-language modeling in which a set of assumptions described in text are turned into a model and then updated by rewriting/adding sentences (2) assembly of a causal network from literature content by performing a series of knowledge-assembly steps (fixing grounding, finding/resolving redundancies, assessing belief, filtering, etc.). In addition, to spice things up, the tutorial will show at least one example with an "open domain" world modeling scenario in addition to molecular biology. The tutorial will hopefully elucidate the steps taken to turn natural language into computational models, and also expose and illustrate INDRA's architecture.