Observable Operator Models (OOMs) are a generalization of hidden Markov models (HMMs). They can be represented by a matrix formalism that is completely analogous to HMMs, with the only difference that negative entries are allowed in the matrices and vectors. This little difference has far-reaching consequences:

- OOMs have a fundamentally different concept of state, namely, a state is an encoding of the future distribution of the process.
- OOMs can model essentially every stochastic process, i.e., they do not specify a particular class of processes but yield a general representation theory of stochastic processes as a subtheory of linear algebra.
- The linear theory of OOMs leads to a novel class of learning algorithms for stochastic processes, which are asymptotically correct, constructive, statistically efficient, and fast.

The talk gives an introduction to the concepts of OOM theory, and sketches current research themes.