State Translation and Geometries of Information and Belief

Kevin G. Kirby

Computer Science Department, Northern Kentucky University, Highland Heights, KY 41099 USA
Email: kirby@nku.edu
URL: http://www.nku.edu/~kirby/bio.html

Abstract: The process of understanding a fragment of nature may be viewed as a dynamic process of continual translation and retranslation between incomplete state specifications. This is fundamentally an informational perspective, and can be deployed at many levels, from the cellular to the societal. This paper explores the value of taking the notion of *translation* as logically prior to notions of *state* and *representation*, a reversal of the conventional approach. To make this concrete, we use this perspective to examine two models of information dynamics that have played a role in artificial intelligence and neural computation. The first is the Helmholtz machine, a type of unsupervised learning architecture that has provided an unusual view of the model formation process. The second is a simplified iterative Bayesian model of belief revision, which permits easy access to some of the notions of information geometry. This model can be viewed as a dynamical system that seeks a resolution between a hypothesis space and an attribute space. It also allows a simple implementation as a recurrent neural network. We show that this dynamics is related to gradient descent in relative entropy. We conclude by pulling back from these specific models, and argue that translation is the key concept involved in understanding how interpreters impute information processing to pieces of the natural and artificial world.

Keywords: information geometry, translation, Bayesian updates