Simulating Science: a Multiagent Model of Scientific Evolution

Nicolas Payette
Department of Philosophy, UQAM

Institutionalized science can be construed as a collective cognitive system distributing tasks of knowledge production and evaluation between multiple agents. Taken together, these agents can be seen as implementing a search algorithm trying to maximize empirical adequacy in theoretical space. There is a family of views in the philosophy of science (falling under the label 'Evolutionary Epistemology') that imply that this algorithm is a 'genetic' one, where some or all of the constituve objects of science (ideas, theories, paradigms, etc.) are produced, transmitted and selected in a Darwinian fashion. The most ambitious and complete proposal among these lines is arguably David Hull's *Science as a Process* (1988). While Hull's theory is very detailed (and empirically justified to a certain extent), it remains a verbal theory that would benefit from formalization.

The project presented here aims to model Hull's theory of the scientific process as a multiagent system and work out its consequences using computer simulation. In this model, scientists (the agents) are situated in a social network of collaborative and teacher-pupils relationships. Scientific ideas are exchanged through direct contact between scientists and the reading/writing of (refereed) papers, giving rise to a Darwinian replication and selection process. Ideas are represented as vectors in a multidimensional conceptual space and their 'empirical adequacy' is tested against an arbitrary objective function. The model thus allows exploration of the conditions under which, given Hull's theory, the collective cognition performed by the scientific community works best.

The proposed poster will present both Hull's theory and the model being constructed from it. On Hull's side will be explications of: replicators, interactors and lineages as the components of his general analysis of the Darwinian process, plus the notions of 'the credit vs. support tradeoff' and 'conceptual inclusive fitness' as key elements of his theory. On the simulation's side will be: its UML class diagram, a flowchart of the algorithm at work, an illustration of scientific ideas as vectors in a theoretical space, a plot of the objective function used to evaluate the empirical adequacy of these ideas and example graphs of social networks in the scientific community.

Hull, David L. 1988. Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science. Chicago: University of Chicago Press.