

Part I

Agent-Based Models

This first part of the text examines the theory and practice of computational modelling, much of it viewed through the lens of artificial life. Artificial life, or Alife for short, is a discipline that focuses on ‘the simulation and synthesis of living systems’, most frequently through the use of simulation. Using agent-based models, evolutionary algorithms, and other recent innovations in simulation and robotics, Alife researchers hope to unravel the mysteries of how life develops and evolves in the real world by studying digital manifestations of ‘life as it could be’.

As Alife has itself evolved over the years, researchers have sought closer connections to the real world and to real biology. This has brought about difficult questions concerning the integration of real data into simulated worlds, and the relationship between digital biology and physical biology. As early Alife has slowly given way to a greater desire for empirical relevance, it has become increasingly important to understand the potential role Alife and Alife-inspired approaches can play in understanding real biological systems.

Of course the difficulties inherent in modelling complex biological processes and populations are familiar to population biologists just as much as digital ones – perhaps even more so, given the short history of Alife. We will examine in detail some of the theoretical frameworks developed by population biologists in order to develop their models and position them as a valid form of enquiry, and investigate how we might use these frameworks as a way to understand and categorise computational modelling efforts in disciplines such as Alife. In so doing, we will lay the foundations for Part II, in which we will investigate the additional modelling complexities we encounter when we begin to model social systems.