Chapter 3

Features of Complex Systems

This chapter uses the representative examples of complex systems discussed in the last chapter to arrive at a list of the distinctive features of complex systems. Chapter 1 explained the early history of complexity science in the 1970s. By the late 1990s the ideas and methods of complexity science had been developed and disseminated widely. There is a snapshot of the views of prominent practising complexity scientists in a special issue of *Science* on 'complex systems' (*Science* April 1999) devoted to a celebration of the new science. These ideas of some of the key figures are still representative of the field and are the starting point for our analysis.

1. "To us, complexity means that we have structure with variations." (Goldenfeld and Kadanoff 1999, p. 87)

2. "In one characterization, a complex system is one whose evolution is very sensitive to initial conditions or to small perturbations, one in which the number of independent interacting components is large, or one in which there are multiple pathways by which the system can evolve. Analytical descriptions of such systems typically require nonlinear differential equations. A second characterization is more informal; that is, the system is 'complicated' by some subjective judgement and is not amenable to exact description, analytical or otherwise." (Whitesides and Ismagilov 1999, p. 89)

3. "In a general sense, the adjective 'complex' describes a system or component that by design or function or both is difficult to understand and verify. ...complexity is determined by such factors as the number of components and the intricacy of the interfaces between them, the number and intricacy of conditional branches, the degree of nesting, and the types of data structures." (Weng et al. 1999, p. 92)