Additional Readings

The following is a list of additional readings rather than a bibliography. The range of topics discussed in this text does not allow for a comprehensive bibliography. Our focus is on the effort to develop concepts and methodologies that enable the study of complex systems in a unified manner. Nevertheless, this effort must be informed by many fields and their phenomenologies. The following list attempts to address this by providing accepted keywords for literature searches as provided by the Library of Congress.

In addition to the keywords, a few references are provided with comments. Many of these texts were obtained from literature searches, and have been checked as relevant to the concepts we have been discussing. These references serve several purposes. First, they provide the student with an opportunity to pursue the phenomenology or theory in greater depth. Second, in a more specific domain, they provide a point of entry into the literature through a bibliography. Third, some references have an approach that is particularly compatible with the material presented in this text, or to the field of complex systems generally.

This list, however, does not serve three conventional purposes. It does not serve to trace the historical origin of concepts presented, or to motivate them from phenomenological grounds, or to prove them using experimental observations. Any of these would be a worthwhile but equally challenging endeavor to the objective of demonstrating the unity of concepts, which is the motivating force behind this text.

As is fitting for concepts that are to be a general underpinning of our understanding of complex systems, points made in this book appear in many contexts in the literature. A stronger statement may be made—the generality of the concepts presented in this text must imply that there are many ways to arrive at them, and many conclusions that may be drawn from them that can be compared with a large body of experimental literature. The effort in this text to draw conclusions from a very small set of assumptions is only a beginning in the effort to understand how widely applicable such concepts can be. In the few cases where we have made a greater effort to make contact with specific phenomenology and thus where support is necessary for material presented in the text (e.g. the discussion of sleep in Chapter 3), we have provided a few more specific references.

Chapter 0

keywords: system theory; autopoiesis; biological systems; chaotic behavior in systems; cybernetics; linear systems; social systems; system analysis; systems engineering; complexity (philosophy)

[0.1] Herbert A. Simon, The Sciences of the Artificial, 3d ed. (MIT Press: Cambridge, 1996). See the last chapter for an alternate overview of this text.

There are a remarkable number of popular or semipopular books on various concepts in the study of complex systems. For a number of reasons these books have appeared instead of textbooks. They are of two types: books written by observers of the field, and books written by researchers presenting their ideas to a popular audience.
There are both positive and negative aspects of this approach, the ultimate benefit of which will be judged by others. Here we provide a few references to this literature:

[0.2] James Gleick, *Chaos: Making a New Science* (Penguin: New York, 1987). Concept and personality history, focusing on chaotic and nonlinear dynamics (Section 1.1), and fractals (Section 1.10) but relevant to the study of complex systems in general.


More technical references include some with classic and others with modern approaches:


A series of books under the collective title “The Santa Fe Institute Studies in the Sciences of Complexity” published by Addison-Wesley, collects various workshops and lectures sponsored by the Santa Fe Institute on subjects relevant to complex systems. This series illustrates the great diversity of concepts and applications of this
field. We do not include a full list of these books here. A few volumes in this series are mentioned below as appropriate.

Chapter 1

Section 1.1
keywords: chaotic behavior in systems


Section 1.2
keywords: probabilities; combinatorial probabilities; correlation (statistics); distribution (probability theory); games of chance (mathematics); limit theorems (probability theory); random variables; stochastic processes; stochastic sequences; random walks (mathematics)

Probability and statistics is a traditional field of study in many fields with varying emphasis depending on whether it is used for analysis of data, for modeling of systems, or for more abstract formal concepts. A reference that is particularly relevant to our purposes is:


Section 1.3
keywords: thermodynamics; statistical physics; statistical mechanics; phase transformations (statistical physics); statistical thermodynamics

Thermodynamics/statistical physics is a traditional field of physics covered by undergraduate and graduate textbooks with various approaches and flavors. Examples include:

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Section 1.4
keywords: chemical reaction, conditions and laws of; chemical kinetics
The two-state system analysis is based on classic transition-state theory covered in many physical chemistry books as a model for chemical reaction kinetics.

Section 1.5
keywords: cellular automata


Section 1.6
keywords: phase transformations (statistical physics); ferromagnetism; Ising model
Most books on statistical physics (Section 1.3) include a discussion of the Ising model. See especially:


Section 1.7
keywords: simulation methods; mathematical models; computer simulation; Monte Carlo method


Additional Readings

Section 1.8
keywords: information theory; statistical communication theory


Section 1.9
keywords: logic, symbolic and mathematical; machine theory; computer science; Turing machines


Section 1.10
keywords: fractals; renormalization group; scaling laws (statistical physics); multigrid methods numerical analysis

The subject of fractals has strong overlaps with the topic of chaos (Section 1.1) due to the connection between multiscale phenomena and chaotic dynamics discussed in Chapter 9. Thus, see also the references in Section 1.1.


and temporal properties of these systems. References on the application of scaling to polymers are given in Chapter 5.


Chapter 2

Keywords: neurophysiology; brain—localization of functions; neural networks (neurobiology); cognitive neuroscience; artificial intelligence; neural networks (computer science); pattern-recognition systems

Discussions of neural function from a biological perspective:


Almost any book on neural networks, of which there are a number, will offer a basic introduction to various types of neural networks including the attractor network and the feedforward network, variations on these networks and other simple models. Unfortunately, the field is polarized, with distinct camps taking different approaches and claiming priority on ideas, realism or other issues. The complexity of biological neural systems enables various approaches to coexist without much more than acknowledging each other. A collection of articles that are central to the development of various threads in the field of neural networks is contained in:


While it is important to respect the value of all approaches, the treatment emphasized in this chapter originates from J. J. Hopfield. This approach emphasizes simplicity of the microscopic components so that collective behavior can be more easily (but still not trivially!) understood. Books expanding on this:


Specific references:


Chapter 3

Section 3.1

keywords: sleep; sleep—physiological aspects

Discussions of sleep phenomenology and models of its function are contained in:


Specific references:


of dolphins sleeping half brain at a time. Among other arguments, refutes
the evolutionary perspective of ref. [3.2].


Section 3.2
keywords: knowledge, theory of; intellect; perception; human information processing;
artificial intelligence; philosophy of mind; cognitive science; memory; psychology of
learning

Specific references:
Mechanism of Classical Conditioning in Aplysia: Activity-Dependent
Amplification of Presynaptic Facilitation” Science 219, 400 (1983); E. R.
Kandel and R. D. Hawkins, Scientific American (September 1992) pp. 78–86,
Experimental studies of the biology of neurons showing synapses that couple
three neurons; e.g. implementing the logical AND operation.

Chapter 4
keywords: proteins; proteins–conformation; protein folding
Note: the problem of identifying time scale can also be seen in other fields. In
computer science see keyword: computational complexity.
[4.2] Carl Branden and John Tooze, Introduction to Protein Structure (Garland: New
[4.3] Alan Ferscht, Enzyme Structure and Mechanism, 2d ed. (Freeman: New York,
1985).
[4.4] Thomas E. Creighton, Proteins: Structures and Molecular Principles (Freeman:
New York, 1983).

Chapter 5
keywords: macromolecules; polymers; polymer solutions; biopolymers
Books on the scaling properties of polymers:
[5.1] Pierre-Gilles de Gennes, Scaling Concepts in Polymer Physics (Cornell
A discussion of parallel-processing simulations is found in:


Specific references:


Chapter 6

Keywords: evolution; evolution (biology); heredity; adaptation (biology); variation (biology); natural selection; genetics; population genetics; cytoplasmic inheritance; egoism; genetic algorithms


Additional Readings

Artificial life references include:

[6.9] Christopher G. Langton, ed. Artificial Life: The Proceedings of an Interdisciplinary Workshop on the Synthesis and Simulation of Living Systems (Addison-Wesley, Reading, Mass., 1989). See also the sequels in the same series, Artificial Life II–IV. See the video for Artificial Life II.


For genetic algorithms, see:


For discussions of the philosophy of egoism—self-interest vs. altruism, see:


Chapter 7

keywords: developmental biology; embryology; pattern formation (biology); chemical reactions


Chapter 8

keywords: Kolmogorov complexity

Additional Readings


Specific references:


Chapter 9

keywords civilization—history, civilization—philosophy; social history; social change; technology and civilization; organization; management; management science; economic history; international economic relations; man—origin

For modeling using system dynamics, a method that was not discussed in this text, see:


Books on the structure of corporations and the recent changes in civilization include:


