



Chaos, Dynamics, and Fractals: An Algorithmic Approach to Deterministic Chaos (Cambridge Nonlinear Science Series)

By Joseph L. McCauley

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This book develops deterministic chaos and fractals from the standpoint of iterated maps, but the method of analysis and choice of emphasis make it very different from all other books in the field. It is written to provide the reader with an introduction to more recent developments, such as weak universality, multifractals, and shadowing, as well as to older subjects such as universal critical exponents, devil's staircases, and the Farey tree. Throughout the book the author uses a fully discrete method, a "theoretical computer arithmetic," because finite (but not fixed) precision is a fact of life that cannot be avoided in computation or in experiment. This approach leads to a more general formulation in terms of symbolic dynamics and to the idea of weak universality. The author explains why continuum analysis, computer simulations, and experiments form three entirely distinct approaches to chaos theory. In the end, the connection is made with Turing's ideas of computable numbers. It is explained why the continuum approach leads to predictions that are not necessarily realized in computations or in nature, whereas the discrete approach yields all possible histograms that can be observed or computed.

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