OMB No. 9129834687052

Self Organization In Biological Systems Princeton Studies In Complexity

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Toward Understanding Complexity, Chaos and Emergent Function in Living Systems
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Complexity and Self-Organization
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Concepts, Implementation and Application

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MOYER JOSIE

Self-Organized Biological Dynamics and Nonlinear Control Springer Science & Business Media
Self-organization of systems belonging to quite different discipl ines has been a central topic of synergetics since its beginning. I am therefore particularly plea sed that Hans Ulrich and Gilbert Probst have not only undertaken to organize an interdisciplinary meeting on Self-Organization and Management of Social Systems, but have also edited these articles written by leading scientists after and based upon that symposium. While the previous volumes of the Springer Series in Synergetics were mainly de voted to physical, chemical and biological systems, with only the book by W. Weidlich and G. Haag deal i ng with "Quant i tat i ve Soc i 01 ogy" (Spri nger Ser. Syn., Vo 1. 14), the present volume opens a new perspective. As the reader will notice, the multitude of facets of self-organization is well reflected by various authors belonging to different discipl ines and representing different schools of thought. When such a wide scope of fields - ranging from phy sics to sociology - is covered, it is not surprising that the existence of a "hiatus" between sociology and the natural sciences was felt by some participants.
Self-Organizing Systems Oxford University Press
This monograph has the ambitious aim of developing a mathematical theory of complex biological systems with special attention to the phenomena of ageing, degeneration and repair of biological tissues under individual self-repair actions that may have good potential in medical therapy.The approach to mathematically modeling biological systems needs to tackle the additional difficulties generated by the peculiarities of living matter. These include the lack of invariance principles, abilities to express strategies for individual fitness, heterogeneous behaviors, competition up to proliferative and/or destructive actions, mutations, learning ability, evolution and many others. Applied mathematicians in the field of living systems, especially biological systems, will appreciate the special class of integro-differential equations offered here for modeling at the molecular, cellular and tissue scales. A unique perspective is also presented with a number of case studies in biological modeling.
Energy and Information Transfer in Biological Systems Academic Press
Complex systems are usually difficult to design and control. There are several particular methods for coping with complexity, but there is no general approach to build complex systems. In this book I propose a methodology to aid engineers in the design and control of complex systems. This is based on the description of systems as self-organizing. Starting from the agent metaphor, the methodology proposes a conceptual framework and a series of steps to follow to find proper mechanisms that will promote elements to find solutions by actively interacting among themselves.

The Search for the Laws of Self-Organization and Complexity

Frontiers Media SA
A clear methodological and philosophical introduction to complexity theory as applied to urban and regional systems is given, together with a detailed series of modelling case studies compiled over the last couple of decades. Based on the new complex systems thinking, mathematical models are developed which attempt to simulate the evolution of towns, cities, and regions and the complicated co-evolutionary interaction there is both between and within them. The aim of these models is to help policy analysis and decision-making in urban and regional planning, energy policy, transport policy, and many other areas of service provision, infrastructure planning, and investment that are necessary for a successful society.
National Academies Press
How can we explain the fundamental paradox of living matter, which combines stability and robustness of form with constant internal dynamics? It is not only the genetic information contained in every cell, but also numerous stochastic biomolecular processes that are at work in morphogenesis. In addition, the shaping of an organism is driven by mechanical forces that operate within and between cells, across tissues and organs. The dynamics of morphogenesis is a self-organized process that emerges from biological control and physical constraints at all scales. Its study is currently bringing together a fast-growing interdisciplinary community that observes, analyses and models living organisms.

Selected Writings on Self-organization, Philosophy, Bioethics, and Judaism

Springer Science & Business Media
A major scientific revolution has begun, a new paradigm that rivals Darwin's theory in importance. At its heart is the discovery of the order that lies deep within the most complex of systems, from the origin of life, to the workings of giant corporations, to the rise and fall of great civilizations. And more than anyone else, this revolution is the work of one man, Stuart Kauffman, a MacArthur Fellow and visionary pioneer of the new science of complexity. Now, in At Home in the Universe, Kauffman brilliantly weaves together the excitement of intellectual discovery and a fertile mix of insights to give the general reader a fascinating look at this new science--and at the forces for order that lie at the edge of chaos. We all know of instances of spontaneous order in nature--an oil droplet in water forms a sphere, snowflakes have a six-fold symmetry. What we are only now discovering, Kauffman says, is that the range of spontaneous order is enormously greater than we had supposed. Indeed, self-organization is a great undiscovered principle of nature. But how does this spontaneous order arise? Kauffman contends that complexity itself triggers self-organization, or what he calls "order for free," that if enough different molecules pass a certain threshold of complexity, they begin to self-organize into a new entity--a living cell. Kauffman uses the analogy of a thousand buttons on a rug--join two buttons randomly with thread, then another two, and so on. At first, you have isolated pairs; later, small clusters; but suddenly at around the 500th repetition, a remarkable transformation occurs--much like the phase transition when water abruptly turns to ice--and the buttons link up in one giant network. Likewise, life may have originated when the mix of different molecules in the primordial soup passed a certain level of complexity and self-organized into living entities (if so, then life is not a highly improbable chance event, but almost inevitable). Kauffman uses the basic insight of "order for free" to illuminate a staggering range of phenomena. We see how a single-celled embryo can grow to a highly complex organism with over two hundred different cell types. We learn how the science of complexity extends Darwin's theory of evolution by natural selection: that self-organization, selection, and

chance are the engines of the biosphere. And we gain insights into biotechnology, the stunning magic of the new frontier of genetic engineering--generating trillions of novel molecules to find new drugs, vaccines, enzymes, biosensors, and more. Indeed, Kauffman shows that ecosystems, economic systems, and even cultural systems may all evolve according to similar general laws, that tissues and terra cotta evolve in similar ways. And finally, there is a profoundly spiritual element to Kauffman's thought. If, as he argues, life were bound to arise, not as an incalculably improbable accident, but as an expected fulfillment of the natural order, then we truly are at home in the universe. Kauffman's earlier volume, The Origins of Order, written for specialists, received lavish praise. Stephen Jay Gould called it "a landmark and a classic." And Nobel Laureate Philip Anderson wrote that "there are few people in this world who ever ask the right questions of science, and they are the ones who affect its future most profoundly. Stuart Kauffman is one of these." In At Home in the Universe, this visionary thinker takes you along as he explores new insights into the nature of life.

Toward Understanding Complexity, Chaos and Emergent Function in Living Systems Oxford University Press

This volume contains papers based on the workshop “Energy and Information Transfer in Biological Systems: How Physics Could Enrich Biological Understanding”, held in Italy in 2002. The meeting was a forum aimed at evaluating the potential and outlooks of a modern physics approach to understanding and describing biological processes, especially regarding the transition from the microscopic chemical scenario to the macroscopic functional configurations of living matter. In this frame some leading researchers presented and discussed several basic topics, such as the photon interaction with biological systems also from the viewpoint of photon information processes and of possible applications; the influence of electromagnetic fields on the self-organization of biosystems including the nonlinear mechanism for energy transfer and storage; and the influence of the structure of water on the properties of biological matter. Contents:Soliton Mechanism of Charge, Energy and Information Transfer in Biosystems (L Brizhik)Delayed Luminescence and Motional Harmonicity (L Cordone et al.)62 AMEV Proton Beam for the Treatment of Ocular Melanoma at LNS — INFN (G Cuttone et al.)Search for Quantum and Classical Modes of Information Processing in Microtubules: Implications for “the Living State” (S Hameroff et al.)From ‘Molecular Machines’ to Coherent Organisms (M-W Ho)On the Physics of Ultraweak Bioluminescence and Intercellular Photon Signaling (V S Letokhov & A L Dobryakov)Nonlinearity in Biological Systems: How Can Physics Help? (A A Marino & C Frilot)Life as a Fourth Level of Quantum Organization of Nature (S P Sit'ko)Concept of Photon Storage Capacity in Cell Biology (R van Wijk)and other papers Readership: Graduate students and researchers in physics and biology. Keywords:Biophysics;Delayed Luminescence;Consciousness;Structure of Water;Electromagnetic Field and Biology;Nonlinearity in Biological Systems;Solitons in Biological Systems;Information and Life

Thermodynamics and Kinetics of Biological Processes Princeton University Press

The synchronized flashing of fireflies at night. The spiraling patterns of an aggregating slime mold. The anastomosing network of army-ant trails. The coordinated movements of a school of fish. Researchers are finding in such patterns--phenomena that have fascinated naturalists for centuries--a fertile new approach to understanding biological systems: the study of self-organization. This book, a primer on self-organization in biological systems for students and other enthusiasts, introduces readers to the basic concepts and tools for studying self-organization and then examines numerous examples of self-organization in the natural world. Self-organization refers to diverse pattern formation processes in the physical and biological world, from sand grains assembling into rippled dunes to cells combining to create highly structured tissues to individual insects working to create sophisticated societies. What these diverse systems hold in common is the proximate means by which they acquire order and structure. In self-organizing systems, pattern at the global level emerges solely from interactions among lower-level components. Remarkably, even very complex structures result from the iteration of surprisingly simple behaviors performed by individuals relying on only local information. This striking conclusion suggests important lines of inquiry: To what degree is environmental rather than individual complexity responsible for group complexity? To what extent have widely differing organisms adopted similar, convergent strategies of pattern formation? How, specifically, has natural selection determined the rules governing interactions within biological systems? Broad in scope, thorough yet accessible, this book is a self-contained introduction to self-organization and complexity in biology--a field of study at the forefront of life sciences research.

Philosophical and Scientific Perspectives on Downward Causation Springer

The contributions to this volume attempt to apply different aspects of Ilya Prigogine's Nobel-prize-winning work on dissipative structures to nonchemical systems as a way of linking the natural and social sciences. They address both the mathematical methods for description of pattern and form as they evolve in biological systems and the mechanisms of the evolution of social systems, containing many variables responding to subjective, qualitative stimuli. The mathematical modeling of human systems, especially those far from thermodynamic equilibrium, must involve both chance and determinism, aspects both quantitative and qualitative. Such systems (and the physical states of matter which they resemble) are referred to as self-organized or dissipative structures in order to emphasize their dependence on the flows of matter and energy to and from their surroundings. Some such systems evolve along lines of inevitable change, but there occur instances of choice, or bifurcation, when chance is an important factor in the qualitative modification of structure. Such systems suggest that evolution is not a system moving toward equilibrium but instead is one which most aptly evokes the patterns of the living world. The volume is truly interdisciplinary and should appeal to researchers in both the physical and social sciences. Based on a workshop on dissipative structures held in 1978 at the University of Texas, contributors include Prigogine, A. G. Wilson, Andre de Palma, D. Kahn, J. L. Deneubourgh, J. W. Stucki, Richard N. Adams, and Erick Jantsch. The papers presented include Allen, "Self-Organization in the Urban System"; Robert Herman, "Remarks on Traffic Flow Theories and the Characterization of Traffic in Cities"; W. H. Zurek and Schieve, "Nucleation Paradigm: Survival Threshold in Population Dynamics"; De Palma et al., "Boolean Equations with Temporal Delays"; Nicholas Georgescu-Roegin, "Energy Analysis and Technology Assessment"; Magoroh Maruyama, "Four Different Causal Meta-types in Biological and Social Sciences"; and Jantsch, "From Self-Reference to Self-Transcendence: The Evolution of Self-Organization Dynamics."

Physics of Self-organization Systems Princeton University Press

During the last thirty years, biophysicist and philosopher Henri Atlan has been a major voice in contemporary European philosophical and bio-ethical debates. In a massive oeuvre that ranges from biology and neural network theory to Spinoza's thought and the history of philosophy, and from artificial intelligence and information theory to Jewish mysticism and to contemporary medical ethics, Atlan has come to offer an exceptionally powerful philosophical argumentation that is as hostile to scientism as it is attentive to biology's conceptual and experimental rigor, as careful with concepts of rationality as it is committed to rethinking the human place in a radically determined yet forever changing world. --Book Jacket.

Proceedings of the 5th 21st Century COE Symposium, Tokyo, Japan, 13-14 September 2007

Oxford University Press

Self-organization in Biological SystemsPrinceton University Press

Complexity and Self-Organization

Routledge

Downward causation plays a fundamental role in many theories of metaphysics and philosophy of mind. It is strictly connected with many topics in philosophy, including but not limited to: emergence, mental causation, the nature of causation, the nature of causal powers and dispositions, laws of nature, and the possibility of ontological and epistemic reductions. Philosophical and Scientific Perspectives on Downward Causation brings together experts from different fields—including William Bechtel, Stewart Clark and Tom Lancaster, Carl Gillett, John Heil, Robin F. Hendry, Max Kistler, Stephen Mumford and Rani Lill Anjum —who delve into classic and unexplored lines of philosophical inquiry related to downward causation. It critically assesses the possibility of downward causation given different ontological assumptions and explores the connection between downward causation and the metaphysics of causation and dispositions. Finally, it presents different cases of downward causation in empirical fields such as physics, chemistry, biology and the neurosciences. This volume is both a useful introduction and a collection of original contributions on this fascinating and hotly debated philosophical topic.

Living Machines Self-organization in Biological Systems

"This volume presents the new objectives of physics on self-organizing systems composed of multi-components, in order to create a new field and establish universal comprehension in physics. The book covers broad topics such as the thermodynamic time asymmetry in both transient and stationary nonequilibrium states, the seriousness of auxiliary conditions in physicochemical processes and biological systems, the quantum-classical and micro-macro interfaces which are familiar in mesoscopic physics, the purification scheme of quantum entanglement, topics on gamma-ray bursts, and the walking mechanism of single molecular motors."--BOOK JACKET.

A Handbook of Research in Biomimetics and Biohybrid Systems McGraw-Hill College

It is man’s ongoing hope that a machine could somehow adapt to its environment by reorganizing itself. This is what the notion of self-organizing robots is based on. The theme of this book is to examine the feasibility of creating such robots within the limitations of current mechanical engineering. The topics comprise the following aspects of such a pursuit: the philosophy of design of self-organizing mechanical systems; self-organization in biological systems; the history of self-organizing mechanical systems; a case study of a self-assembling/self-repairing system as an autonomous distributed system; a self-organizing robot that can create its own shape and robotic motion; implementation and instrumentation of self-organizing robots; and the future of self-organizing robots. All topics are illustrated with many up-to-date examples, including those from the authors’ own work. The book does not require advanced knowledge of mathematics to be understood, and will be of great benefit to students in the robotics discipline, including in the areas of mechanics, control, electronics, and computer science. It is also an important source for researchers who wish to investigate the field of robotics or who have an interest in the application of self-organizing phenomena.

Evolutionary Systems Elsevier

Originally published in 1987, the purpose of this title was to develop a conceptual framework for understanding individual humans as complex, functional entities. It was felt that a sound developmental theory of human personality and behaviour would help synthesize existing scientific and clinical information into a coherent representation of a person as a functional unit, guide future research, and facilitate the work of the health and human services professions. The volume is aimed at a multidisciplinary-multiprofessional audience.

the science of self-organized criticality Fordham Univ Press

Natural phenomena consist of simultaneously occurring transport processes and chemical reactions. These processes may interact with each other and may lead to self-organized structures, fluctuations, instabilities, and evolutionary systems. Nonequilibrium Thermodynamics, Third Edition updates and expands on the first and second editions by focusing on the general balance equations for coupled processes of physical, chemical, and biological systems. The new edition contains a new chapter on stochastic approaches to include the statistical thermodynamics, mesoscopic nonequilibrium thermodynamics, fluctuation theory, information theory, and modeling the coupled biochemical systems in thermodynamic analysis. This new addition also comes with more examples and practice problems. Informs and updates on all the latest developments in the field Contributions from leading authorities and industry experts A useful text for seniors and graduate students from diverse engineering and science programs to analyze some nonequilibrium, coupled, evolutionary, stochastic, and dissipative processes Highlights fundamentals of equilibrium thermodynamics, transport processes and chemical reactions Expands the theory of nonequilibrium thermodynamics and its use in coupled transport processes and chemical reactions in physical, chemical, and biological systems Presents a unified analysis for transport and rate processes in various time and space scales Discusses stochastic approaches in thermodynamic analysis including fluctuation and information theories Has 198 fully solved examples and 287 practice problems An Instructor Resource containing the Solution Manual can be obtained from the author: ydemirel2@unl.edu

Protein Folding and Supramolecular Assembly Oxford University Press

Systems biology is a vigorous and expanding discipline, in many ways a successor to genomics and perhaps unprecedented in its combination of biology with a great many other sciences, from physics to ecology, from mathematics to medicine, and from philosophy to chemistry. Studying the philosophical foundations of systems biology may resolve a longer standing issue, i.e., the extent to which Biology is entitled to its own scientific foundations rather than being dominated by existing philosophies. * Answers the question of what distinguishes the living from the non-living * An in-depth look to a vigorous and expanding discipline, from molecule to system * Explores the region between individual components and the system

Models of Complexity

National Academies Press

Self-organized criticality, the spontaneous development of systems to a critical state, is the first general theory of complex systems with a firm mathematical basis. This theory describes how many seemingly desperate aspects of the world, from stock market crashes to mass extinctions, avalanches to solar flares, all share a set of simple, easily described properties. "...a'must read'...Bak writes with such ease and lucidity, and his ideas are so intriguing...essential reading for those interested in complex systems...it will reward a sufficiently skeptical reader." -NATURE "...presents the theory (self-organized criticality) in a form easily absorbed by the non-mathematically inclined reader." -BOSTON BOOK REVIEW "I picture Bak as a kind of scientific musketeer; flamboyant, touchy, full of swagger and ready to join every fray... His book is written with panache. The style is brisk, the content stimulating. I recommend it as a bracing experience." -NEW SCIENTIST

Self-Organization in Biological Systems World Scientific

The three well known revolutions of the past centuries - the Copernican, the Darwinian and the Freudian - each in their own way had a deflating and mechanizing effect on the position of humans in nature. They opened up a richness of disillusion: earth acquired a more modest place in the universe, the human body and mind became products of a long material evolutionary history, and human reason, instead of being the central, immaterial, locus of understanding, was admitted into the theater of discourse only as a materialized and frequently out-of-control actor. Is there something objectionable to this picture? Formulated as such, probably not. Why should we resist the idea that we are in certain ways, and to some degree, physically, biologically or psychically determined? Why refuse to acknowledge the fact that we are materially situated in an ever evolving world? Why deny that the ways of inscription (traces of past events and processes) are co-determinative of further "evolutionary pathways"? Why minimize the idea that each intervention, of each natural being, is temporally and materially situated, and has, as such, the inevitable consequence of changing the world? The point is, however, that there are many, more or less radically different, ways to consider the "mechanization" of man and nature. There are, in particular, many ways to get the message of "material and evolutionary determination", as well as many levels at which this determination can be thought of as relevant or irrelevant.

Molecular Mechanisms of Autonomy in Biological Systems Cambridge University Press

A clear and concise introduction to this new, cross-disciplinary field.