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*How does a bird flock keep its movements so graceful and synchronized? Most people assume that the bird in front leads and the others follow. In fact, bird flocks don't have leaders:*

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*they are organized without an organizer, coordinated without a coordinator. And a surprising number of other systems, from termite colonies to traffic jams to economic systems, work the same decentralized way. Turtles, Termites, and Traffic Jams describes innovative new computational tools that can help people (even young children) explore the workings of such systems—and help them move beyond the centralized mindset.*

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*This undergraduate text explores a variety of large-scale phenomena - global warming, ice ages, water, poverty - and uses these case studies as a motivation to explore nonlinear dynamics, power-law statistics, and complex systems. Although the detailed mathematical descriptions of these topics can be challenging, the consequences of a system being nonlinear, power-law, or complex are in fact quite accessible. This book blends*

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*a tutorial approach to the mathematical aspects of complex systems together with a complementary narrative on the global/ecological/societal implications of such systems. Nearly all engineering undergraduate courses focus on mathematics and systems which are small scale, linear, and Gaussian.*

*Unfortunately there is not a single large-scale ecological or social phenomenon that is scalar, linear, and Gaussian. This book offers students*

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*insights to better understand the large-scale problems facing the world and to realize that these cannot be solved by a single, narrow academic field or perspective. Instead, the book seeks to emphasize understanding, concepts, and ideas, in a way that is mathematically rigorous, so that the concepts do not feel vague, but not so technical that the mathematics get in the way. The book is intended for undergraduate students in a technical domain such as*

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engineering, computer science, physics, mathematics, and environmental studies. How do scientists model crowd behaviour, epidemics, earthquakes or the internet? What can we learn from the collective intelligence and adaptability of an ant colony? This book answers such questions by highlighting common themes in the study of complex systems. Topics covered include self-organisation, emergence, agent-based simulations, complex

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*networks, phase plane plots, fractals, chaos, measures of complexity, model building, and the scientific method. Explanations are simple and concise, with common misconceptions clarified. Numerous exercises help enthusiasts consolidate their understanding through peer learning. Supplementary resources are at the companion websites [www.simplicitysg.net/books](http://www.simplicitysg.net/books) and [www.facebook.com/simcomty](http://www.facebook.com/simcomty). For many organizations, the way in*

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*which projects are managed is a fundamental factor in how well they can prosper in today's marketplace. Unfortunately, the current solutions available to companies for managing projects are proving to be increasingly ineffective in a complex world that is becoming more and more dynamic and unpredictable. Organization's pay for this complexity in delayed time-to-market, slow response to customer needs, and decreased productivity.*



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*While tweaking the current project management paradigm may provide some minimal gains, to have a real impact requires a fundamental change in mindset. New business models like Uber and AirBnB show us that the most efficient operations in today's business environment behave like complex adaptive systems (CAS) where self-managing participants, following a set of simple rules, organize themselves to solve incredibly complex*

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*problems. Instead of trying to function like a "well-oiled machine" where things "work like clockwork", companies like Uber function more like an organism that is alive and constantly changing. They fully embrace the characteristics of a CAS. Viewing an organization as a complex adaptive system drives a radically new philosophy of project management that is much better suited to the needs of the 21st-century organization and can*

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*provide the quantum leap improvement in project production that we are looking for. This book exposes the assumptions underlying the accepted paradigm of project management, describes the common practices that are based on those assumptions, analyzes why these practices are unhelpful and even harmful, and proposes an alternative, sometimes seemingly counter intuitive approach to project management based on CAS thinking. By the end of the book,*

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*the reader will have a completely new perspective on the way projects can be managed in their organization, and how they can quickly start reaping the benefits provided by a CAS-driven management methodology and supporting toolset that is more in tune with today's business demands - and that turns complexity into a competitive advantage.*

*Networks of the Brain*

*Introduction to Complex Adaptive*

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*Systems-of-Systems (CASoS) Engineering  
Language and Material Culture  
A Contemporary Software Engineering  
Perspective*

*Complex Adaptive Systems, Resilience  
and Security in Cameroon*

*Society-- a Complex Adaptive System  
An Introduction to Computational Models  
of Social Life*

Loosely speaking, adaptive systems are designed to deal with, to adapt to, changing environmental conditions whilst maintaining performance

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objectives. Over the years, the theory of adaptive systems evolved from relatively simple and intuitive concepts to a complex multifaceted theory dealing with stochastic, nonlinear and infinite dimensional systems. This book provides a first introduction to the theory of adaptive systems. The book grew out of a graduate course that the authors taught several times in Australia, Belgium, and The Netherlands for students with an engineering and/or mathematics background. When we taught the course for the first time, we felt that there was a need for a textbook that would introduce the reader to the main aspects

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of adaptation with emphasis on clarity of presentation and precision rather than on comprehensiveness. The present book tries to serve this need. We expect that the reader will have taken a basic course in linear algebra and multivariable calculus. Apart from the basic concepts borrowed from these areas of mathematics, the book is intended to be self contained.

This book links the emerging concepts of complexity, complex adaptive system (CAS) and resilience to forest ecology and management. It explores how these concepts can be applied in various forest

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biomes of the world with their different ecological, economic and social settings, and history. Individual chapters stress different elements of these concepts based on the specific setting and expertise of the authors. Regions and authors have been selected to cover a diversity of viewpoints and emphases, from silviculture and natural forests to forest restoration, and from boreal to tropical forests. The chapters show that there is no single generally applicable approach to forest management that applies to all settings. The first set of chapters provides a global overview of how complexity, CAS and resilience



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theory can benefit researchers who study forest ecosystems. A second set of chapters provides guidance for managers in understanding how these concepts can help them to facilitate forest ecosystem change and renewal (adapt or self-organize) in the face of global change while still delivering the goods and services desired by humans. The book takes a broad approach by covering a variety of forest biomes and the full range of management goals from timber production to forest restoration to promote the maintenance of biodiversity, quality of water, or carbon storage.

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This book brings together a series of overview articles that appeared in the first three issues of the groundbreaking journal *Artificial Life*.

Genetic algorithms are playing an increasingly important role in studies of complex adaptive systems, ranging from adaptive agents in economic theory to the use of machine learning techniques in the design of complex devices such as aircraft turbines and integrated circuits. *Natural and Artificial Systems* is the book that initiated this field of study, presenting the theoretical foundations and exploring applications. In its most

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familiar form, adaptation is a biological process, whereby organisms evolve by rearranging genetic material to survive in environments confronting them. In this now classic work, Holland presents a mathematical model that allows for the nonlinearity of such complex interactions. He demonstrates the model's universality by applying it to economics, physiological psychology, game theory, and artificial intelligence and then outlines the way in which this approach modifies the traditional views of mathematical genetics. Initially applying his concepts to simply defined artificial systems with limited

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numbers of parameters, Holland goes on to explore their use in the study of a wide range of complex, naturally occurring processes, concentrating on systems having multiple factors that interact in nonlinear ways. Along the way he accounts for major effects of coadaptation and coevolution: the emergence of building blocks, or schemata, that are recombined and passed on to succeeding generations to provide, innovations and improvements.

Growing Artificial Societies  
An Overview

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A Unified Framework for Modeling Complex  
Adaptive Systems using Agent-based & Complex  
Network-based Methods

A Very Short Introduction  
Artificial Life

Undoing Unintended Consequences for the Earth's  
Survival

Adaptive Systems

A comprehensive and hands-on introduction to the  
core concepts, methods, and applications of agent-  
based modeling, including detailed NetLogo examples.  
The advent of widespread fast computing has enabled

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us to work on more complex problems and to build and analyze more complex models. This book provides an introduction to one of the primary methodologies for research in this new field of knowledge. Agent-based modeling (ABM) offers a new way of doing science: by conducting computer-based experiments. ABM is applicable to complex systems embedded in natural, social, and engineered contexts, across domains that range from engineering to ecology. An Introduction to Agent-Based Modeling offers a comprehensive description of the core concepts, methods, and applications of ABM. Its hands-on approach—with hundreds of examples and exercises using

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NetLogo—enables readers to begin constructing models immediately, regardless of experience or discipline. The book first describes the nature and rationale of agent-based modeling, then presents the methodology for designing and building ABMs, and finally discusses how to utilize ABMs to answer complex questions. Features in each chapter include step-by-step guides to developing models in the main text; text boxes with additional information and concepts; end-of-chapter explorations; and references and lists of relevant reading. There is also an accompanying website with all the models and code.

This volume traces the modern critical and performance

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history of this play, one of Shakespeare's most-loved and most-performed comedies. The essay focus on such modern concerns as feminism, deconstruction, textual theory, and queer theory.

"Growing Artificial Societies" is a milestone in social science research. It vividly demonstrates the potential of agent-based computer simulation to break disciplinary boundaries. It does this by analyzing in a unified framework the dynamic interactions of such diverse activities as trade, combat, mating, culture, and disease. It is an impressive achievement." -- Robert Axelrod, University of Michigan How do social structures and group behaviors arise from the



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interaction of individuals? "Growing Artificial Societies" approaches this question with cutting-edge computer simulation techniques. Fundamental collective behaviors such as group formation, cultural transmission, combat, and trade are seen to "emerge" from the interaction of individual agents following a few simple rules. In their program, named Sugarscape, Epstein and Axtell begin the development of a "bottom up" social science that is capturing the attention of researchers and commentators alike. The study is part of the 2050 Project, a joint venture of the Santa Fe Institute, the World Resources Institute, and the Brookings Institution. The project is an international

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effort to identify conditions for a sustainable global system in the next century and to design policies to help achieve such a system. "Growing Artificial Societies" is also available on CD-ROM, which includes about 50 animations that develop the scenarios described in the text. "Copublished with the Brookings Institution"

An overarching framework for comparing and steering complex adaptive systems is developed through understanding the mechanisms that generate their intricate signal/boundary hierarchies.

The Value of Systems and Complexity Sciences for Healthcare

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Simplicity in Complexity

Creative Management of Complex Systems

An Introduction to Natural Computation

Thriving at the Edge of Chaos

Social Sustainability, Past and Future

What You Need to Know to Make Data Work for You

***This book provides a comprehensive introduction to the computational material that forms the underpinnings of the currently evolving set of brain models. It is now clear that the brain is unlikely to be understood without***

***recourse to computational theories. The theme of An Introduction to Natural Computation is that ideas from diverse areas such as neuroscience, information theory, and optimization theory have recently been extended in ways that make them useful for describing the brains programs. This book provides a comprehensive introduction to the computational material that forms the underpinnings of the currently evolving set of brain models. It stresses the broad***

***spectrum of learning models—ranging from neural network learning through reinforcement learning to genetic learning—and situates the various models in their appropriate neural context. To write about models of the brain before the brain is fully understood is a delicate matter. Very detailed models of the neural circuitry risk losing track of the task the brain is trying to solve. At the other extreme, models that represent cognitive constructs can be so abstract***

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***that they lose all relationship to neurobiology. An Introduction to Natural Computation takes the middle ground and stresses the computational task while staying near the neurobiology. This book provides the first clear, comprehensive, and accessible account of complex adaptive social systems, by two of the field's leading authorities. Such systems--whether political parties, stock markets, or ant colonies--present some of the most intriguing theoretical***

***and practical challenges confronting the social sciences. Engagingly written, and balancing technical detail with intuitive explanations, Complex Adaptive Systems focuses on the key tools and ideas that have emerged in the field since the mid-1990s, as well as the techniques needed to investigate such systems. It provides a detailed introduction to concepts such as emergence, self-organized criticality, automata, networks, diversity, adaptation, and***

***feedback. It also demonstrates how complex adaptive systems can be explored using methods ranging from mathematics to computational models of adaptive agents. John Miller and Scott Page show how to combine ideas from economics, political science, biology, physics, and computer science to illuminate topics in organization, adaptation, decentralization, and robustness. They also demonstrate how the usual extremes used in modeling can***



***be fruitfully transcended.***

***This volume contains the proceedings of the international conference "Complexity and Industrial Clusters: Dynamics and Models in Theory and Practice", organized by Fondazione Comunita e Innovazione and held in Milan on June 19 and 20, 2001 under the aegis of the Accademia Nazionale dei Lincei (founded in Rome in 1604), one of the oldest and most famous national academies of science in the world. Fondazione***

***Comunita e Innovazione encourages research and the dissemination of knowledge about social, economic, cultural and civil issues. It promotes research and innovation related to local production systems and industrial districts, with special reference to: the interactions between large companies and SMEs (small and medium-size enterprises), the effects of industrial districts on the development and welfare of their communities and of***

***neighbouring areas, the effects of globalisation on these local systems of productions. Fondazione Comunita e Innovazione was created in Milan in 1999. It supports studies, publications, and events, both on its own and in cooperation with corporations, research institutes, foundations, associations and universities. It also grants scientific sponsorship to research that is in line with its mission, as set forth in its by-laws. The founding member of the***

***Fondazione is Edison (formerly Monted:son). The other subscribing members, in historical order, are: Ausimont, Tecnimont, Eridania, Accenture, and PricewaterhouseCoopers. This innovative and provocative work introduces complexity theory and its application to both the study of language and the study of material culture. The book begins with a wide-ranging theoretical background, covering the areas of dialect geography, the***

***anthropological study of material culture, and a general introduction to the study of complex adaptive systems. Following this general introduction, the principles of complexity theory are demonstrated in data drawn from linguistics and material culture studies. "Language and Material Culture" further highlights the principles of complexity through a series of case studies, using data from the Linguistic Atlas, colonial American inventories and the Historic***

***American Building Survey. "LMC" shows that language and material culture are intertwined as they interact within the same cultural complex system. The book is designed for students in courses that focus on language variation, American English and material culture, in addition to general courses on applications of complex systems.***

***How Adaptation Builds Complexity  
Essays in Social Theory  
Complexity and Industrial Clusters***

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***Complex Adaptive Systems  
An Introductory Analysis with  
Applications to Biology, Control, and  
Artificial Intelligence  
On the Programming of Computers by  
Means of Natural Selection  
Complex and Adaptive Dynamical  
Systems***

*This book is an introduction to health care as a complex adaptive system, a system that feeds back on itself. The first section introduces systems and complexity theory from a science, historical,*

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*epistemological, and technical perspective, describing the principles and mathematics. Subsequent sections build on the health applications of systems science theory, from human physiology to medical decision making, population health and health services research. The aim of the book is to introduce and expand on important population health issues from a systems and complexity perspective, highlight current research developments and their implications for health care delivery, consider their ethical implications, and to suggest directions for and*



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*potential pitfalls in the future.*

*This book provides an introduction to the role of diversity in complex adaptive systems. A complex system--such as an economy or a tropical ecosystem--consists of interacting adaptive entities that produce dynamic patterns and structures. Diversity plays a different role in a complex system than it does in an equilibrium system, where it often merely produces variation around the mean for performance measures. In complex adaptive systems, diversity makes fundamental contributions to system performance. Scott Page*

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*gives a concise primer on how diversity happens, how it is maintained, and how it affects complex systems. He explains how diversity underpins system level robustness, allowing for multiple responses to external shocks and internal adaptations; how it provides the seeds for large events by creating outliers that fuel tipping points; and how it drives novelty and innovation. Page looks at the different kinds of diversity--variations within and across types, and distinct community compositions and interaction structures--and covers the evolution of diversity within complex*

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*systems and the factors that determine the amount of maintained diversity within a system. Provides a concise and accessible introduction Shows how diversity underpins robustness and fuels tipping points Covers all types of diversity The essential primer on diversity in complex adaptive systems This primer offers readers an introduction to the central concepts that form our modern understanding of complex and emergent behavior, together with detailed coverage of accompanying mathematical methods. All calculations are presented step by step and are easy to follow. This*

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*new fourth edition has been fully reorganized and includes new chapters, figures and exercises. The core aspects of modern complex system sciences are presented in the first chapters, covering network theory, dynamical systems, bifurcation and catastrophe theory, chaos and adaptive processes, together with the principle of self-organization in reaction-diffusion systems and social animals. Modern information theoretical principles are treated in further chapters, together with the concept of self-organized criticality, gene regulation networks, hypercycles and*

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*coevolutionary avalanches, synchronization phenomena, absorbing phase transitions and the cognitive system approach to the brain. Technical course prerequisites are the standard mathematical tools for an advanced undergraduate course in the natural sciences or engineering. Each chapter includes exercises and suggestions for further reading, and the solutions to all exercises are provided in the last chapter. From the reviews of previous editions: This is a very interesting introductory book written for a broad audience of graduate students in natural sciences and*

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*engineering. It can be equally well used both for teaching and self-education. Very well structured and every topic is illustrated with simple and motivating examples. This is a true guidebook to the world of complex nonlinear phenomena. (Ilya Pavlyukevich, Zentralblatt MATH, Vol. 1146, 2008)*

*Claudius Gros' Complex and Adaptive Dynamical Systems: A Primer is a welcome addition to the literature. A particular strength of the book is its emphasis on analytical techniques for studying complex systems. (David P. Feldman, Physics Today, July, 2009).*

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*This visionary reframing of health and healthcare uses a complexity science approach to building healthcare systems that are accessible, effective, and prepared for change and challenges. Its holistic map for understanding the human organism emphasizes the interconnectedness of the individual's physical, psychological, cognitive, and sociocultural functioning. Applications of this approach are described in primary, specialist, and emergency care and at the organizational and policy levels, from translating findings to practice, to problem solving and evaluation. In this model,*

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*the differences between disease and illness and treating illness and restoring health are not mere wordplay, but instead are robust concepts reflecting real-world issues and their solutions. Based on the Proceedings of the 1st International Conference of Systems and Complexity for Healthcare, topics covered include:*

- *Coping with complexity and uncertainty: insights from studying epidemiology in family medicine*
- *Anticipation in complex systems: potential implications for improving safety and quality in healthcare*
- *Monitoring variability and complexity at the*



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*bedside • Viewing mental health through the lens of complexity science • Ethical complexities in systems healthcare: what care and for whom? • The value of systems and complexity thinking to enable change in adaptive healthcare organizations supported by informatics • If the facts don't fit the theory, change the theory: implications for health system reform The Value of Systems and Complexity Sciences for Healthcare will interest and inspire health and disease researchers, health professionals, health care planners, health system financiers, health system administrators, health*

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*services administrators, health professional educators, and, last but not least, current and future patients.*

*An Introduction to Agent-Based Modeling  
Modeling Natural, Social, and Engineered Complex Systems with NetLogo*

*Introduction to the Theory of Complex Systems  
Society, Ecology, and Nonlinear Dynamics*

*Dynamics and Models in Theory and Practice  
Diversity and Complexity*

*Introduction to Urban Science*

**Complex Adaptive Systems, Resilience and**

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Security in Cameroon comprehensively maps and analyses Cameroon's security architecture to determine its resilience. The author examines the key actors involved in Cameroon's security and evaluates the organisational structures, before analysing the different security systems that arise from the interplay between the two. He also shows how these security networks can be better conceived as complex adaptive systems, interdependent on other environmental, economic and societal systems. In this

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regard, security actors become security agents. Finally, arguing that security should be pursued from a resilience perspective, this book seeks to comment on the contemporary situation in Cameroon and its possible trajectory for the future. Providing a timely assessment of security in Cameroon, this book will be of interest to scholars and students of African politics and Security Studies.

An integrative overview of network approaches to neuroscience explores the origins of brain complexity and the link

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between brain structure and function. Over the last decade, the study of complex networks has expanded across diverse scientific fields. Increasingly, science is concerned with the structure, behavior, and evolution of complex systems ranging from cells to ecosystems. In *Networks of the Brain*, Olaf Sporns describes how the integrative nature of brain function can be illuminated from a complex network perspective. Highlighting the many emerging points of contact between neuroscience and network science, the book

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serves to introduce network theory to neuroscientists and neuroscience to those working on theoretical network models. Sporns emphasizes how networks connect levels of organization in the brain and how they link structure to function, offering an informal and nonmathematical treatment of the subject. Networks of the Brain provides a synthesis of the sciences of complex networks and the brain that will be an essential foundation for future research.

Complex Systems are made up of numerous

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interacting sub-components. Non-linear interactions of these components or agents give rise to emergent behavior observable at the global scale. Agent-based modeling and simulation is a proven paradigm which has previously been used for effective computational modeling of complex systems in various domains. Because of its popular use across different scientific domains, research in agent-based modeling has primarily been vertical in nature. The goal of this manuscript is to provide a single hands-on guide to developing

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cognitive agent-based models for the exploration of emergence across various types of complex systems. We present practical ideas and examples for researchers and practitioners for the building of agent-based models using a horizontal approach - applications are demonstrated in a number of exciting domains as diverse as wireless sensors networks, peer-to-peer networks, complex social systems, research networks, epidemiological HIV

How complex systems theory sheds new light



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on the adaptive dynamics of viral populations Viruses are everywhere, infecting all sorts of living organisms, from the tiniest bacteria to the largest mammals. Many are harmful parasites, but viruses also play a major role as drivers of our evolution as a species and are essential regulators of the composition and complexity of ecosystems on a global scale. This concise book draws on complex systems theory to provide a fresh look at viral origins, populations, and evolution, and the coevolutionary dynamics of viruses

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and their hosts. New viruses continue to emerge that threaten people, crops, and farm animals. Viruses constantly evade our immune systems, and antiviral therapies and vaccination campaigns can be powerless against them. These unique characteristics of virus biology are a consequence of their tremendous evolutionary potential, which enables viruses to quickly adapt to any environmental challenge. Ricard Solé and Santiago Elena present a unified framework for understanding viruses as complex adaptive systems. They show how

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the application of complex systems theory to viral dynamics has provided new insights into the development of AIDS in patients infected with HIV-1, the emergence of new antigenic variants of the influenza A virus, and other cutting-edge advances. Essential reading for biologists, physicists, and mathematicians interested in complexity, *Viruses as Complex Adaptive Systems* also extends the analogy of viruses to the evolution of other replicators such as computer viruses, cancer, and languages.

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**Evidence and Theory of Cities as Complex Systems**

**An Introduction**

**Managing Forests as Complex Adaptive Systems**

**Complexity**

**An Introduction to Complex Systems**

**Language as a Complex Adaptive System**

A novel, integrated approach to understanding long-term human history, viewing it as the long-term evolution of human information-processing. This title is also available as Open Access.

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A novel, integrative approach to cities as complex adaptive systems, applicable to issues ranging from innovation to economic prosperity to settlement patterns. Human beings around the world increasingly live in urban environments. In *Introduction to Urban Science*, Luis Bettencourt takes a novel, integrative approach to understanding cities as complex adaptive systems, claiming that they require us to frame the field of urban science in a way that goes beyond existing theory in such traditional disciplines as sociology, geography, and economics. He explores the processes facilitated by and, in many cases, unleashed for the first time by urban life through the lenses of social heterogeneity, complex networks, scaling, circular

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causality, and information. Though the idea that cities are complex adaptive systems has become mainstream, until now those who study cities have lacked a comprehensive theoretical framework for understanding cities and urbanization, for generating useful and falsifiable predictions, and for constructing a solid body of empirical evidence so that the discipline of urban science can continue to develop. Bettencourt applies his framework to such issues as innovation and development across scales, human reasoning and strategic decision-making, patterns of settlement and mobility and their influence on socioeconomic life and resource use, inequality and inequity, biodiversity, and the challenges of sustainable

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development in both high- and low-income nations. It is crucial, says Bettencourt, to realize that cities are not "zero-sum games" and that knowledge, human cooperation, and collective action can build a better future.

A concise and practical introduction to the foundations and engineering principles of self-adaptation Though it has recently gained significant momentum, the topic of self-adaptation remains largely under-addressed in academic and technical literature. This book changes that. Using a systematic and holistic approach, *An Introduction to Self-adaptive Systems: A Contemporary Software Engineering Perspective* provides readers with an accessible set of basic principles, engineering foundations, and applications of

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self-adaptation in software-intensive systems. It places self-adaptation in the context of techniques like uncertainty management, feedback control, online reasoning, and machine learning while acknowledging the growing consensus in the software engineering community that self-adaptation will be a crucial enabling feature in tackling the challenges of new, emerging, and future systems. The author combines cutting-edge technical research with basic principles and real-world insights to create a practical and strategically effective guide to self-adaptation. He includes features such as: An analysis of the foundational engineering principles and applications of self-adaptation in different domains, including the Internet-of-Things,



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cloud computing, and cyber-physical systems End-of-chapter exercises at four different levels of complexity and difficulty An accompanying author-hosted website with slides, selected exercises and solutions, models, and code Perfect for researchers, students, teachers, industry leaders, and practitioners in fields that directly or peripherally involve software engineering, as well as those in academia involved in a class on self-adaptivity, this book belongs on the shelves of anyone with an interest in the future of software and its engineering.

This book is a general presentation of complex systems, examined from the point of view of management. There is no standard formula to govern such systems, nor to

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effectively understand and respond to them. The interdisciplinary theory of self-organization is teeming with examples of living systems that can reorganize at a higher level of complexity when confronted with an external challenge of a certain magnitude. Modern businesses, considered as complex systems, ideally know how to flexibly and resiliently adapt to their environment, and also how to prepare for change via self-organization. Understanding sources of potential crisis is essential for leaders, though not all crises are necessarily bad news, as creative firms know how to respond to challenges through innovation: new products and markets, organizational learning for collective intelligence, and more.

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Adaptation in Natural and Artificial Systems

Hidden Order

The Mind, The Brain And Complex Adaptive Systems

The Science of Complex Systems in Business, Life, and  
Society

Managing Projects as Complex Adaptive Systems

An Introduction to Genetic Algorithms

A Primer

***Basic elements - Adaptive agents - Echoing  
emergence - Simulating echo - Toward theory.***

***Elements of Artificial Neural Networks provides a  
clearly organized general introduction, focusing on a  
broad range of algorithms, for students and others***

***who want to use neural networks rather than simply study them. The authors, who have been developing and team teaching the material in a one-semester course over the past six years, describe most of the basic neural network models (with several detailed solved examples) and discuss the rationale and advantages of the models, as well as their limitations. The approach is practical and open-minded and requires very little mathematical or technical background. Written from a computer science and statistics point of view, the text stresses links to contiguous fields and can easily serve as a first course for students in economics and management. The opening chapter sets the stage, presenting the***

***basic concepts in a clear and objective way and tackling important -- yet rarely addressed -- questions related to the use of neural networks in practical situations. Subsequent chapters on supervised learning (single layer and multilayer networks), unsupervised learning, and associative models are structured around classes of problems to which networks can be applied. Applications are discussed along with the algorithms. A separate chapter takes up optimization methods. The most frequently used algorithms, such as backpropagation, are introduced early on, right after perceptrons, so that these can form the basis for initiating course projects. Algorithms published as late as 1995 are also***

***included. All of the algorithms are presented using block-structured pseudo-code, and exercises are provided throughout. Software implementing many commonly used neural network algorithms is available at the book's website. Transparency masters, including abbreviated text and figures for the entire book, are available for instructors using the text.***

***Implement successful and cost-effective enterprise architecture projects. This book provides a new approach to developing enterprise architecture based on the idea of emergent behaviors—where instead of micromanaging system implementation, the enterprise architecture effort establishes clear goals***

***and leaves the details to the implementation teams. System development efforts are measured based on their contribution to achieving business goals instead of implementing specific (possibly outdated) requirements. Most enterprise architecture initiatives employ one of the existing system architecture frameworks such as Zachman or The Open Group Architecture Framework, but these are not well-suited for enterprise architecture in a modern, agile organization. The new approach presented in this book is based on the author's experience with large enterprise architecture efforts. The approach leverages research into complex adaptive systems and emergent behaviors, where a***

***few simple rules result in complex and efficient enterprise behaviors. Simplifying the task of establishing and maintaining the enterprise architecture cuts the costs of building and maintaining the architecture and frees up those resources for more productive pursuits. System implementers are given the freedom to rapidly adapt to changing user needs without the blessing of the enterprise modeling priesthood, and the architecture is transformed from a static pile of obscure models and documents into an operational framework that can be actively used to manage an enterprise's resources to better achieve business goals. The enterprise architect is free to stop focusing on***



***building and maintaining models and start focusing on achieving business goals. What You'll Learn Refocus enterprise architecture on business needs by eliminating most of the enterprise-level models Delegate tasks to the development teams who do system implementation Document business goals, establish strategies for achieving those goals, and measure progress toward those goals Measure the results and gauge whether the enterprise architecture is achieving its goals Utilize appropriate modeling techniques that can be effectively used in an enterprise architecture Who This Book Is For Architecture practitioners and architecture managers: Practitioners are experienced architects***

***who have used existing frameworks such as Zachman, and have experience with formal architecture modeling and/or model-based system engineering; managers are responsible for managing an enterprise architecture project and either have experience with enterprise architecture projects that were ineffective or are looking for a different approach that will be more cost-effective and allow for more organizational agility. Government program managers looking for a different approach to make enterprise architecture more relevant and easier to implement will also find this book of value.***

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engineering as adaptive algorithms for solving practical problems and as computational models of natural evolutionary systems. This brief, accessible introduction describes some of the most interesting research in the field and also enables readers to implement and experiment with genetic algorithms on their own. It focuses in depth on a small set of important and interesting topics—particularly in machine learning, scientific modeling, and artificial life—and reviews a broad span of research, including the work of Mitchell and her colleagues. The descriptions of applications and modeling projects stretch beyond the strict boundaries of computer science to include dynamical systems theory, game theory, molecular biology, ecology, evolutionary biology, and population genetics, underscoring the exciting "general

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purpose" nature of genetic algorithms as search methods that can be employed across disciplines. An Introduction to Genetic Algorithms is accessible to students and researchers in any scientific discipline. It includes many thought and computer exercises that build on and reinforce the reader's understanding of the text. The first chapter introduces genetic algorithms and their terminology and describes two provocative applications in detail. The second and third chapters look at the use of genetic algorithms in machine learning (computer programs, data analysis and prediction, neural networks) and in scientific models (interactions among learning, evolution, and culture; sexual selection; ecosystems; evolutionary activity). Several approaches to the theory of genetic algorithms are discussed in depth in the fourth

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chapter. The fifth chapter takes up implementation, and the last chapter poses some currently unanswered questions and surveys prospects for the future of evolutionary computation. In this Very Short Introduction, John Holland presents an introduction to the science of complexity. Using examples from biology and economics, he shows how complexity science models the behaviour of complex systems.

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regression to random walks and far beyond—that can turn anyone into a genius. At the core of the book is Page's "many-model paradigm," which shows the reader how to apply multiple models to organize the data, leading to wiser choices, more accurate predictions, and more robust designs. The Model Thinker provides a toolkit for business people, students, scientists, pollsters, and bloggers to make them better, clearer thinkers, able to leverage data and information to their advantage.

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into pieces and examining it one shard at a time. While you could probably learn a lot about each piece, you would have no idea about what the entire picture looks like. This is reductionism -- the idea that to understand the world we only need to study its pieces -- and it is how most social scientists approach their work. In *A Crude Look at the Whole*, social scientist and economist John H. Miller shows why we need to start looking at whole pictures. For one thing, whether we are talking about stock markets, computer networks, or biological organisms, individual parts only make sense when we remember that they are part of larger wholes. And perhaps more importantly, those wholes can take on behaviors that are strikingly different

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from that of their pieces. Miller, a leading expert in the computational study of complex adaptive systems, reveals astounding global patterns linking the organization of otherwise radically different structures: It might seem crude, but a beehive's temperature control system can help predict market fluctuations and a mammal's heartbeat can help us understand the "heartbeat" of a city and adapt urban planning accordingly. From enduring racial segregation to sudden stock market disasters, once we start drawing links between complex systems, we can start solving what otherwise might be totally intractable problems. Thanks to this revolutionary perspective, we can finally transcend the limits of reductionism and

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discover crucial new ideas. Scientifically founded and beautifully written, *A Crude Look at the Whole* is a powerful exploration of the challenges that we face as a society. As it reveals, taking the crude look might be the only way to truly see.

Based upon a conference held in May 1993, this book discusses the intersection of neurobiology, cognitive psychology and computational approaches to cognition.

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