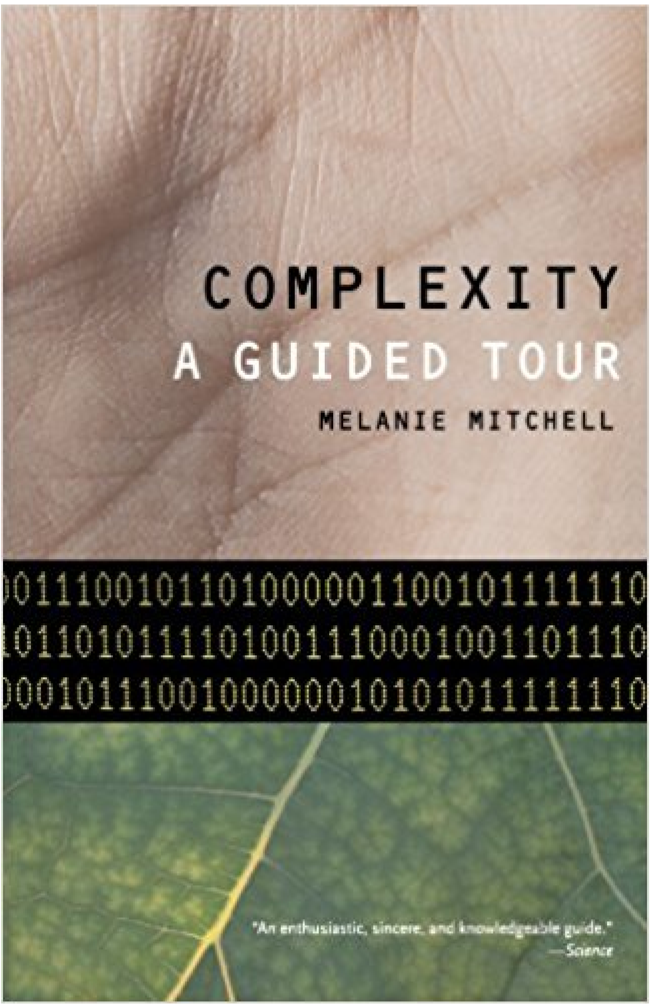
Complexity: A Guided Tour



Synopsis

What enables individually simple insects like ants to act with such precision and purpose as a group? How do trillions of neurons produce something as extraordinarily complex as consciousness? In this remarkably clear and companionable book, leading complex systems scientist Melanie Mitchell provides an intimate tour of the sciences of complexity, a broad set of efforts that seek to explain how large-scale complex, organized, and adaptive behavior can emerge from simple interactions among myriad individuals. Based on her work at the Santa Fe Institute and drawing on its interdisciplinary strategies, Mitchell brings clarity to the workings of complexity across a broad range of biological, technological, and social phenomena, seeking out the general principles or laws that apply to all of them. Richly illustrated, Complexity: A Guided Tour--winner of the 2010 Phi Beta Kappa Book Award in Science--offers a wide-ranging overview of the ideas underlying complex systems science, the current research at the forefront of this field, and the prospects for its contribution to solving some of the most important scientific questions of our time.

Book Information

Paperback: 368 pages

Publisher: Oxford University Press; 1 edition (September 1, 2011)

Language: English

ISBN-10: 0199798109

ISBN-13: 978-0199798100

Product Dimensions: 9.2 x 1.1 x 6.1 inches

Shipping Weight: 1.4 pounds (View shipping rates and policies)

Average Customer Review: 4.2 out of 5 stars   111 customer reviews

Best Sellers Rank: #65,107 in Books (See Top 100 in Books)   #22 inÃ Â Books > Science & Math > Physics > System Theory   #3391 inÃ Â Books > Textbooks > Science & Mathematics

Customer Reviews

Ã¢â ¬Å“All theoretical models are wrong, but some are useful.Ã¢â ¬Â• Both inevitable error and promising usefulness abound in the bold conceptual models that Mitchell surveys in exploring the nascent science of complexity. Readers will marvel at the sheer range of settings in which complex systems operate: from ant hills to the stock market, from T cells to Web searches, from disease epidemics to power outages, complexity challenges theoristsÃ¢â ¬â„¢ intellectual adroitness. With refreshing clarity, Mitchell invites nonspecialists to share in these researchersÃ¢â ¬â„¢ adventures in recognizing and measuring complexity and then predicting its cascading effects. Concepts central to thermodynamics, information theory, and computer programming all come into focus in this foray into the recesses of complexity. Still, the analysis illuminates more than explanatory frameworks (such as network diagrams and genetic algorithms); piquant personalities (including Stephen Jay Gould andÃ Â John von Neumann) also receive illuminating scrutiny. Though Mitchell acknowledges the doubts of skeptics, she still expresses hope that persistent complexity researchers will yet weld their disparate accomplishments into a coherent paradigm. Mind-expanding. --Bryce Christensen --This text refers to the Hardcover edition.

Melanie Mitchell's book is most enjoyable, truly inspiring, skillfully written, and, above all, beautifully clear. The author's enthusiasm and passion for the field make the book fascinating to read. Her rigor, clarity, and healthy skepticism make the book sound and the field scientifically stronger. It is an excellent and rigorous account of the scientific field of complexity. She proves by example that it is possible to explain complex systems science with rigor, breadth, depth, and- above all-exquisite clarity. * Artificial Life *

Complexity: A Guided Tour, by Melanie Mitchell, Ph.D.One of my favorite books from the early 1980s was a huge tome titled GÃƒÂ¶del, Escher, Bach: An Eternal Golden Braid, by Douglas Hofstadter, a pioneer in Artificial Intelligence (AI). Hofstadter described GEB (the initials became a popular abbreviation for his book) as "a metaphorical fugue on minds and machines in the spirit of Lewis Carroll". At the time I was just getting interested in AI and I found GEB fascinating. Apparently, I was not alone. Melanie Mitchell, then a high school mathematics teacher in New York, found it "one of those life-changing events that one can never anticipate".She wrote to Hofstadter that she wanted to study under him as a graduate student. Receiving no reply, she later approached him in person when he gave a lecture at MIT. He handed her off to a graduate student. She was "disappointed, but not deterred" and after several more follow-up calls to him, she managed, through her persistence, to convince him of her passion for AI - a topic that eventually was absorbed into Complexity Science. Eventually, she moved to Michigan and earned her Ph.D. under Hofstadter and John Holland, another complexity science pioneer. I mention this history to try to convey the contagious enthusiasm for complexity science that Dr. Mitchell exudes in her book. She seems to prefer the term complexity sciences, since this is such a cross disciplinary subject; but in this review I'll use the more common term complexity science.Mitchell starts with an acknowledgement to the Santa Fe Institute (SFI) where she directed an SFI Complex Systems Summer School. The SFI seems to be the current epicenter for complexity science research, and this book is an expansion of the author's series of SFI lectures on "The Past and Future of the Sciences of Complexity", with updated material reflecting new perspectives from 2008 and 2009.Previous knowledge of complexity science is unnecessary, as the first chapter starts out with a series of examples to describe what is meant by complexity. This was useful since the topic seems to evoke many different definitions from scientists and practitioners. Those of us in the financial sector like to start with some definition of the topic under study; but a rigorous and widely accepted definition of complexity science just does not exist yet. On the other hand, we spend vast amounts of time developing potential strategies for risk management - even though we may differ considerably in our opinions about what constitutes risk. In a similar vein, Mitchell's examples make it clear what falls into the realm of complexity. The examples run the gamut from insect colonies to the human brain; and from immune systems to economies and the World Wide Web. In some respects, ERM seems like an application of complexity science; and quoting A.S. Eddington, the astronomer who first demonstrated that Einstein's Theory of Relativity worked in the real world, "We need scarcely add that the contemplation in natural science of a wider domain than the actual leads to a far better understanding of the actual." I submit that a study of the wider domain of complexity science can help us better understand risk management. In fact, lest the finance oriented person reading this review assumes that the book mentions only theory and some science applications, the author peppers her theory with references to practical financial applications in several sections. She explains early on that:Economies are complex systems in which the "simple, microscopic" components consist of people (or companies) buying and selling goods, and the collective behavior is the complex, hard-to-predict behavior of markets as a whole, such as changes in the price of housing in different areas of the country or fluctuations in stock prices.And later in the book she gives specific examples: GAs [Genetic Algorithms] have been used by several financial organizations for various tasks: detecting fraudulent trades (London Stock Exchange), analysis of credit card data (Capital One), and forecasting financial markets and portfolio optimization (First Quadrant).Her extensive notes section refers the reader to details about each of these specific applications.In Complexity: A Guided Tour, we are given a short history lesson on the roots of Dynamical Systems Theory, Chaos, and Prediction. Again, the examples help guide the reader through an inductive learning process. Deterministic Chaos, for example, is introduced via the famous Logistic Map that results from varying values of R in the seemingly simple equation xt+1=R*xt*(1-xt) where 0'xt'1. Along the way, we hone in on Feigenbaum's constant, a universal constant for functions approaching chaos via period doubling, and the fact that it applies outside the realm of pure mathematics and shows up in electronic circuits, lasers and chemical reactions.Now, we are ready to approach the concepts of Information, Energy, Work and Entropy. This is explained through stories about the development of the Second Law of Thermodynamics, Maxwell’s Demon, and Shannon’s Information Theory. Moving along to Computation, Mitchell guides us through topics such as "What is Computation and What Can Be Computed?" She describes Hilbert’s Problems and Godel’s Theorem, which proved that not all mathematical questions are computable. Then she covers Turing machines, where the goal is to mimic human behavior so well as to fool a human, and this leads into a chapter on evolution. Her primer on evolution summarizes pre-Darwin, Darwin, Mendel and the Modern Synthesis, and leads quite naturally into the next chapter, on Genetics. Skipping quickly through an admittedly simplified treatment of DNA and RNA Mitchell leads us into the geometry of fractals, and the underlying power laws that describe them when normal measurement techniques fail us.Now with approximately 100 pages of history and basic tutorials behind us, we can begin the next parts of the book, which deal with topics such as life and evolution in computers, cellular automata, information processing in living systems, genetic algorithms, ant colony optimizations, and the mystery of scaling. Clearly oriented towards AI, the author devotes a major chapter to applying network science to real-world networks - such as the brain.Each topic is approached in a logical, understandable manner. In addition though, as a reader I felt the excitement of the discovery process as I read about Von Neumann’s self-reproducing automation, the "new Kind of Science" from Wolfram, and the gradual increase in intelligence of Robby, the soda-can-collecting robot, like the movie robot WALL*E, which eventually outperformed the author in developing its own clean-up strategy.A chapter is devoted to an overview of the author’s development of "copycat" - a program she wrote for her doctoral dissertation that makes analogies in the letter-string world by using reasoning believed similar to that used by humans as we make analogies to understand our world.The examples often caused me to stop and write a quick spreadsheet or program to further explore the particular subject.This is one of the first books I read on Complexity Science; and admittedly many of the ones I read afterwards were more narrowly focused; and some went into more detail, or provided even more memorable examples on particular complexity science topics. However, this book gave me a base level understanding of a lot of topics that previously were just fancy sounding phrases. More than that, it nurtured my initial interest in complexity science and left me with a voracious appetite for more! The subtitle is appropriate. This is truly a guided tour for complexity. Dr. Mitchell is an excellent guide; and I recommend her for your visit to the amazing world of Complexity Science.

I’m a philosopher of science specializing in the foundations of complex systems theory, and this is absolutely the best comprehensive introduction to the field that I've come across. Mitchell is a computer science professor, as well as part of the Santa Fe Institute, so she's absolutely a reliable source on this topic. The book is extremely accessible for someone with very little background in dynamical systems theory or higher mathematics, and despite being mostly non-technical, does a good job actually articulating the central problems and concepts clearly without sacrificing precision or accuracy. It's a wonderful overview of the field, and I highly recommend it to anyone who is curious about what the hell a "complex system" is, why they're worth studying, and how science is learning to deal with them. Anyone interested in where science (and philosophy of science) will be headed during the 21st century should pick this book up: the study of complex systems is poised to be the next "big thing" (or paradigm shift) within the natural sciences, and it's relevant to a really mind-boggling array of contemporary scientific, social, political, and philosophical problems.

This is not an encyclopedia. To appreciate it, you will have to spend just a little time considering what Dr. Mitchell has to present. While no math is required, it is helpful to know some. No science background is required, but it is beneficial to have had at least a couple of classes in science.I read many of the one and two star grumbles below before I posted this. Somehow, they missed the point of her book. The world is far more complex and fascinating than we imagined. She integrates birds, broccoli, social networks, earthquakes, and economic concepts by presenting some of the hidden common factors.Is this complete? No. The field seems to be at a similar point to where the mathematics was before the birth of Leibnitz and Newton. On the other hand, you might suddenly see a connection no one else has. Here is an example. There is a similarity between the studies of cities, information theory concepts, and ants. Enjoy the exploration.

This is an interesting ramble through some of the issues of complexity. Noteworthy is the idea that certain regularities and similarities emerge even in highly non linear systems that are superficially very different. Having just completed an ecosystems course at Open University I was surprised that some of these concepts were not paid more attention to.However, along with Soft Systems Methodology, the hope of a science of complex systems seems to have eluded us; and it does not look now that we will ever get there. It book seemed a little over optimistic given that the quest had run its course and in retrospect the personal details seem no longer all that relevant.So I was left a little disappointed as much by the subject as the exposition. Buts its worth a read just to see if you reach the same conclusions.

Complexity: A Guided Tour Simply Complexity: A Clear Guide to Complexity Theory Guided Meditation: 30 Minute Guided Meditation for Sleep, Relaxation, & Stress Relief ((Self Hypnosis, Affirmations, Guided Imagery & Relaxation Techniques) Anchorage, Alaska Tour: A Self-guided Pictorial Walking Tour (Visual Travel Tours) Brunei Tour: A Self-guided Walking/Public Transit Tour (Visual Travel Tours Book 262) Historic Munich City Tour: A Self-guided Walking Tour (Visual Travel Tours Book 86) Vatican, Rome Tour: A Self-guided Pictorial Walking Tour (Visual Travel Tours Book 65) Tour Johannesburg - Rosebank Art & Shopping: A Self-guided Pictorial Walking Tour (Visual Travel Tours Book 328) Brisbane Tour, Queensland, Austraila: A Self-guided Pictorial Sightseeing Tour (Visual Travel Tours Book 213) Savannah Walking Tour & Guidebook - Self Guided History Tour Raleigh North Carolian Highlights Tour: A Self-guided Pictorial Walking Tour (visualtraveltours Book 283) Salt Lake City Tour: A Self-guided Pictorial Sightseeing Tour (visualtraveltours Book 266) How to be a Tour Guide: The Essential Training Manual for Tour Managers and Tour Guides Guided Mindfulness Meditation: A Complete Guided Mindfulness Meditation Program from Jon Kabat-Zinn Guided Meditation: 30 Minute Guided Meditation for Sleep, Relaxation, & Stress Relief Mindfulness Meditation for Beginners: Learn to Meditate and Become More Mindful with Guided Meditation, Self Hypnosis, Affirmations, Guided Imagery and Relaxation Techniques The Next Step Forward in Guided Reading book + The Guided Reading Teacher’s Companion Submarine: A Guided Tour Inside a Nuclear Warship (Tom Clancy’s Military Referenc) The Machu Picchu Guidebook: A Self-Guided Tour Submarine: A Guided Tour Inside a Nuclear Warship (Tom Clancy’s Military Reference)