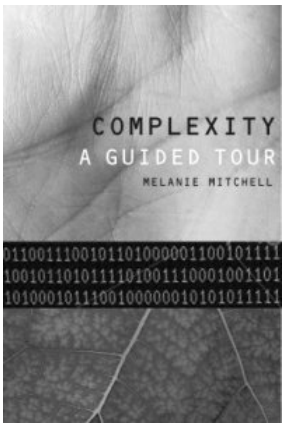
AVANT, Vol. III, No. 2/2012
ISSN: 2082-6710 avant.edu.pl/en

Complexity is around us
a review of Complexity: A Guided Tour

Author: Melanie Mitchell
Publisher: Oxford University Press
Release date: 2009
Number of pages: 368



Dawid Lubiszewski
Department of Philosophy of Science
Nicolaus Copernicus University, Torun, Poland

Received 17 September 2012; accepted 6 December 2012; published online 24 December 2012.

What is complexity? Why are some things complex and others are not? Why cannot complex things be captured by methods used by classical reductionism, and why does the understanding of complexity matter today? If these questions are too general, then perhaps: how does an ant colony organize itself? How does the immune system work? What is a logistic map and fractal dimension?

These are some of the questions that Melanie Mitchell tries to answer in her guidebook to the phenomenon of complexity. Does she succeed? Well, in my opinion she does because it is not just a simple book about complexity. It is a book written with passion, where a large number of topics are related to biographic stories. It is a fascinating introduction to many interdisciplinary issues that have one word in common - complexity.

The title of the book suggests that it is addressed to newcomers and certain explanations are simplified as much as possible, as they might be in a book for high school students. However, there are also topics that can attract scientists who are already familiar with the field of complexity. The last chapter concerns the current state of researches about complexity and includes a discussion about whether complexity sciences (if they even exist) may be interesting for scientists. I believe that this book could be easily understood by anyone who is interested in computer science, mathematics or genetics. Mitchell manages to write and explain important aspects with clar-

ity without becoming too technical and claims that no special background is required. However, those without any basic knowledge of computer science or sciences of complexity may nevertheless find some parts of the book difficult, even though Mitchell tries to avoid mathematical equations whenever possible. And this is the first thing that makes my opinion about the book mixed. In general, there are some topics in complex sciences that, in order to be understood, require mathematical equations to be a part of their explanation and one simply cannot avoid them. Then again, *Complexity: A Guided Tour* covers a large number of issues arising from different areas of science, so there will always be some readers for whom certain topics are going to be more difficult to understand than others.

The other misgiving I have experienced is related to the missing feeling of being, so to speak, guided. The author at times provides too many details. While some items are presented in a technical way I felt on numerous occasions that some connection between different subjects was missing and one could easily forget what was the relevance of presented issues. Different aspects of the subject were not navigated properly, and I did not experience the "eureka" feeling when I completed the final chapter. As for the guide, I would rather know where I am at the moment, why I am there and where I am going. It was hard to sense that guidance while reading this book.

What are the advantages of this book? The first one is history. Mitchell explains very well what the pre-twentieth-century scientists thought about the universe and how the discoveries made in the twentieth century reshaped our science. She also does a good job in showing why a phenomenon of complexity is now one of the most challenging subjects for contemporary researchers.

The second one concerns the large number of issues that are covered, ranging from the purely physical to the biological and the social ones. Mitchell provides accessible and clear explanations for such topics as: dynamical systems theory, chaotic dynamical systems, information, information processing in living systems, fractals, computation, computer modelling, networks, scaling relationships and power laws, cellular automata, genetic algorithms, evolution, and molecular genetics. Nevertheless, I wish Mitchell had gone into some more detail on the notion of emergence (its history, philosophical connections and current problems).

The most compelling part of the book occurs when Mitchell explains the theory of information and computation and ties this theory with evolution. She shows how genetic algorithms and other computer-based mechanisms (such as cellular automata) are able to evolve, and can solve certain problems. But that is hardly surprising, since she is a professor of computer science and her major work concerns the areas of genetic algorithms and cellular automata.

Other advantages of the book include the critique and challenges it posed to well-known theories. The author offers an alternative views on Wolfram's New Kind of Science (NKS) and game theory. These parts are also fascinating because - for some researchers - NKS is essential to understanding complex systems.

As for the structure, the book is divided into five parts. Part one is an introduction to complexity, chaos, information, evolution, and is supported with background history. Part two moves to the topic of life and evolution in computers. However, some interesting examples of artificial life (such as: boids, Langton's ant) are never mentioned. Part three is devoted to computation and here Mitchell provides the alternative view on Wolfram's work. Part four explores networks and issues that exist on the social level. Finally, the last (fifth) part concerns the past and the future of the sciences of complexity. Every chapter is also supplemented with pictures of the problems under discussion and photographs of the individuals who contributed to certain theories and discoveries.

Melanie Mitchell has provided a valuable overview of complexity for newcomers (if you do not know what complexity is) and people from the field (if you want to challenge some popular views, such as NKS or the existence of science of complexity). I enjoyed this book and can recommend it for everyone who is not afraid of entering the complex world of complexity.

The publication was carried out by Nicolaus Copernicus University under the departmental grant no. 339-H.