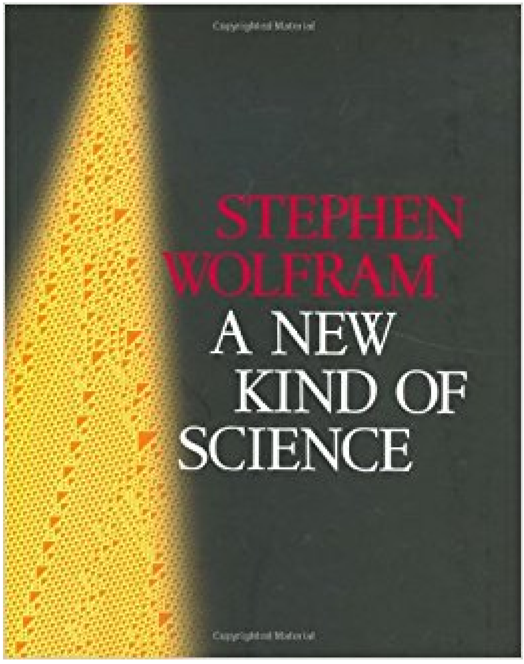
A New Kind Of Science



Synopsis

Challenging the traditional mathematical model of scientific description, a scientist proposes a new dynamic computational approach that utilizes simple codes to generate patterns of ultimate complexity.

Book Information

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Customer Reviews

This review took almost one year. Unlike many previous referees (rank them by .com’s "most helpful" feature) I read all 1197 pages including notes. Just to make sure I won’t miss the odd novel insight hidden among a million trivial platitudes.On page 27 Wolfram explains "probably the single most surprising discovery I have ever made:" a simple program can produce output that seems irregular and complex.This has been known for six decades. Every computer science (CS) student knows the dovetailer, a very simple 2 line program that systematically lists and executes all possible programs for a universal computersuch as a Turing machine (TM). It computes all computable patterns, including all those in Wolfram’s book, embodies the well-known limits of computability, and is basis of uncountable CS exercises.Wolfram does know (page 1119) Minsky’s very simple universal TMs from the 1960s. Using extensive simulations, he finds a slightly simpler one. New science? Small addition to old science. On page 675 we find a particularly simple cellular automaton (CA) and Matthew Cook’s universality proof(?). This might be the most interesting chapter. It reflects that today’s PCs are more powerful systematic searchers for simple rules than those of 40 years ago. No new paradigm though.Was Wolfram at least first to view programs as potential explanations of everything? Nope. That was Zuse. Wolfram mentions him in exactly one line (page 1026): "Konrad Zuse suggested that [the universe] could be a continuous CA." This is totally misleading. Zuse's 1967 paper suggested the universe is DISCRETELY computable, possibly on a DISCRETE CA just like Wolfram's. Wolfram's causal networks (CA's with variable toplogy, chapter 9) will run on any universal CA a la Ulam & von Neumann & Conway & Zuse.

If a million scientists worked on a million experiments for three hundred years, would they learn as much about the universe as Stephen Wolfram does by sitting at his computer for twenty years?Apparently not, according to Stephen Wolfram.I'm annoyed with Wolfram for forcing me to poke fun at him like this. I've been waiting for this book a long time, and I genuinely wanted to give it a thumbs up. Unfortunately, Wolfram has made that impossible.I gave the book three stars, but in fact I consider it almost un-ratable. What do you do with a 1200-page tome that contains a wealth of substantive and fascinating results, but which is insists, at every turn, to draw over-blown and under-supported conclusions from them? I split the difference and gave it a middling rating, but that does not convey the deep ambivalence I feel toward this work.Given Wolfram's reputation, I expected a certain amount of hubris, and even looked forward to it. Most scientists work hard to suppress the egotism that drives them, but Wolfram's ego is out there in the open. While this can be refreshing, what I found here left me dumbfounded. For Wolfram, all of scientific history is either prelude or footnote to his own work on 1-D cellular automata. On pages 12-16 he breezily cites other work in chaos theory, non-linear dynamics and complexity theory. At the end of the book, there are hundreds of pages of footnotes describing previous history as essentially one damn thing after another - a testament to all the people that didn't see the promised land, as he has.Wolfram attempts to usurp all credit for the "computational perspective." Assertions such as "the discoveries in this book showing that simple rules can lead to complex behavior" are repeated to the point of exhaustion.

This is a book of ruminations about cellular automata. It is chiefly concerned with the way that the state of a system evolves when deterministic rules are applied to it. The simplest system is a single point in either state 0 or state 1. The transition rule could be that the state "0" changes to state "1", and state "1" changes to state "0". That rule can be expressed as follows. If the system's initial state is 1, then the transition rule (repeatedly applied) yields the following alternating pattern of states. 1 0 1 0 . .For hundreds of pages the author discusses the behavior of 1-dimensional automata built from 3-cell transition rules. The 2^3=8 different states of a 3-cell cluster can be written in binary notation from 000 up to 111. The cell in the middle can transition to either of two binary states, yielding a total of 2^8=256 rules. Most rules lead to periodically repeating behaviors, with short periods like the alternating pattern shown above.An exception is rule 30 (30 in binary is 00011110; these bits the right-hand-side values for the 8 transitions). rule 30: { 111->0, 110->0, 101->0, 100->1, 011->1, 010->1, 001->1, 000->0 }When applied to an initial state of a single 1 surrounded by 0's, rule 30 generates the following pattern (developing downward from the top row). The array can be displayed as a bitmap of black and white pixels, producing a visualization of the evolving state of the horizontal rows. ..00000000100000000.. ..00000001110000000.. ..00000011001000000.. ..00000110111100000.. ..00001100100010000.. ..00011011110111000.. ..00110010000100100.. ..01101111001111110..