



Contents

Preface	ix
How to Use This Book	xiii

PART I Probabilistic Systems

1. The Random Walk	3
One- and two-dimensional walks, calculating the mean shape of a walk, determining the critical exponent, visualizing the walk	
2. The Self-Avoiding Walk	17
Slithering snake motion, rearrangement by pivoting	
3. Accretion	31
Diffusion-limited aggregation, determining the fractal dimension, ballistic deposition, visualizing DLAs	
4. Spreading Phenomena	45
Single cluster growth, invasion percolation	
5. Percolation Clustering	57
Random site percolation, cluster labeling with the Hoshen-Kopelman algorithm, continuum percolation	
6. The Ising Model	75
Probabilistic Ising model, the Metropolis method, magnetization behavior	

7.	<i>Darwinian Evolution</i>	83
	Co-evolution and punctuated equilibrium	

PART II Cellular Automata

	<i>Cellular Automata Preliminaries</i>	91
	Defining a cellular automaton, lattices, neighborhoods, boundary conditions	
8.	<i>The Game of life</i>	97
	Game of Life, diffusion, boiling and weathering cellular automata	
9.	<i>Avalanches</i>	105
	Self-organized criticality, sandpiles	
10.	<i>The Q2R Ising Model</i>	111
	Ising cellular automaton	
11.	<i>Excitable Media</i>	117
	Self-propagating patterns, neuron action, cyclic space cellular automata, the hodgepodge machine for oscillatory chemical reactions	
12.	<i>Traffic</i>	135
	One-lane traffic with car stopping, two-lane one-way road with car passing, accidents and road work, the fundamental diagram	
13.	<i>Forest Fires</i>	147
	Deforestation, reforestation, forest size distribution	
14.	<i>Complexity</i>	157
	One-dimensional cellular automata, Wolfram rules, animations	

PART III Appendices

A.	<i>Mathematica Programming</i>	173
	Expressions, patterns, evaluation, rewrite rules, transformation rules, higher-order functions	

B.	Random Numbers	207
	Random number generators, tests for randomness, using different probability distributions	
C.	Computer Simulations and MathLink	221
	Using MthLink to call external programs from within Mathematica, techniques in <i>MathLink</i> programming, by Todd Gayley	
D.	Remote Computing with Mathematica	255
	Connecting to a remote computer with a local front end, computing across networks	
E.	MathLink Program Listing	263
	A listing of all <i>MathLink</i> programs including Walk2DC, SeedRandomC, PhasesC, SandpileC, OneLaneC, EpidemicC, and LifeGameC	
	Index	291