
Contents

Preface to the Third Edition	ix
Author	xiii
I One Dimensional Dynamics	1
1 A Visual and Historical Tour	3
1.1 Images from Dynamical Systems	3
1.2 A Brief History of Dynamics	6
2 Examples of Dynamical Systems	19
2.1 Population Models	20
2.2 Newton's Method	23
3 Elementary Definitions	25
3.1 Orbits	25
3.2 Geometric Views of Orbits	27
4 Hyperbolicity	33
4.1 Types of Periodic Points	33
4.2 A Glimpse of Bifurcations	37
5 An Example: The Logistic Family	41
5.1 The Simplest Case	41
5.2 The Cantor Set Case	44
6 Symbolic Dynamics	49
6.1 The Sequence Space	49
6.2 The Shift Map	50
7 Topological Conjugacy	53
7.1 The Itinerary Map	53
7.2 Conjugacy	55
8 Chaos	61
9 Structural Stability	67

10 Sharkovsky's Theorem	75
11 The Schwarzian Derivative	85
12 Bifurcations	97
12.1 Examples of Bifurcations	97
12.2 General Bifurcation Theorems	102
13 Another View of Period Three	111
13.1 Subshifts of Finite Type	111
13.2 The Period 3 Case	113
14 The Period-Doubling Route to Chaos	121
14.1 Renormalization	121
14.2 The Orbit Diagram	125
15 Homoclinic Points and Bifurcations	135
15.1 Homoclinic Points	135
15.2 Homoclinic Bifurcations	138
16 Maps of the Circle	143
16.1 Rotation Numbers	144
16.2 The Standard Family	149
17 Morse-Smale Diffeomorphisms	155
II Complex Dynamics	163
18 Quadratic Maps Revisited	165
18.1 The Case $c = 0$	165
18.2 The Case $ c > 2$	167
18.3 The Case $c = -2$	169
19 Normal Families and Exceptional Points	173
20 Periodic Points	177
20.1 Linearization	177
20.2 Critical Values in the Basins of Attraction	181
21 Properties of the Julia Set	185
22 The Geometry of the Julia Sets	191
22.1 Quadratic Julia Sets	191
22.2 A Julia Set for a Rational Map	199
22.3 Fractals	202

23 Neutral Periodic Points	211
23.1 Rationally Indifferent Periodic Points	211
23.2 Irrationally Indifferent Periodic Points	216
24 The Mandelbrot Set	223
24.1 Connectivity of the Julia Set	223
24.2 The Mandelbrot Set	226
24.3 Complex Bifurcations	231
24.4 Geometry of the Principal Bulbs	236
24.5 External Rays in the Dynamical Plane	241
24.6 External Rays in the Parameter Plane	245
25 Rational Maps	253
25.1 Singular Perturbations	253
25.2 Basic Properties	254
25.3 The Escape Trichotomy	256
25.4 The Special Case $n = 2$	262
25.5 Sierpinski Holes	267
26 The Exponential Family	275
26.1 The Cantor Bouquet Case	276
26.2 The Julia Set of e^z	280
26.3 Indecomposable Continua	283
III Higher Dimensional Dynamics	291
27 Dynamics of Linear Maps	293
27.1 Behavior of Linear Maps	293
27.2 Stable and Unstable Subspaces	297
28 The Smale Horseshoe Map	303
28.1 Symbolic Dynamics	306
29 Hyperbolic Toral Automorphisms	313
29.1 Hyperbolic Toral Automorphisms	314
29.2 Markov Partitions	318
30 Attractors	325
30.1 The Solenoid	325
30.2 The Plykin Attractor	332
31 The Stable and Unstable Manifold Theorem	339
32 Global Results and Hyperbolic Maps	357

33 The Hopf Bifurcation	365
33.1 Planar Bifurcations	365
33.2 Normal Forms	368
33.3 The Hopf Bifurcation Theorem	373
34 The Hénon Map	377
A Mathematical Preliminaries	385
A.1 Preliminaries from Calculus	385
A.2 Preliminaries from Geometry and Topology	392
A.3 Preliminaries from Complex Analysis	394
A.4 Preliminaries from Linear Algebra	400
Bibliography	413
Index	417