Contents

Preface xi

Chapter 1 An Introduction to Evolutionary Computation 1
An Introduction to Simulated Evolutionary Optimization 3
D. B. Fogel (IEEE Transactions on Neural Networks, 1994).
Evolutionary Computation: Comments on the History and Current State 15

Chapter 2 Evolving Control Circuits for Autonomous Robots 29
Selective Feedback Computers for Engineering Synthesis and Nervous System Analogy 30

Chapter 3 Simulating the Evolution of Genetic Systems 85
Simulation of Genetic Systems by Automatic Digital Computers. I. Introduction 87
Computers in the Study of Evolution 95
J. L. Crosby (Scientific Programming Tools & Techniques, 1967).
The Evolution of Purposive Behavior 109
A. S. Fraser (Purposive Systems, 1968).

Chapter 4 Evolving Online Productivity 119
Evolutionary Operation: A Method for Increasing Industrial Productivity 121

Chapter 5 Evolving Computer Programs 143
A Learning Machine: Part I 145
A Learning Machine: Part II 157

Chapter 6 Artificial Life and Evolving Strategies 163
Numerical Testing of Evolution Theories. Part I: Theoretical Introduction and Basic Tests 166
Numerical Testing of Evolution Theories. Part II: Preliminary Tests of Performance, Symbiogenesis and
Terrestrial Life 198

Chapter 7 Artificial Intelligence through Simulated Evolution 227
Artificial Intelligence through a Simulation of Evolution 230
Sciences Symposium, 1965).
Natural Automata and Prosthetic Devices 255

Chapter 8 Evolutionary Experimentation 297
Cybernetic Solution Path of an Experimental Problem 301
I. Rechenberg (Royal Aircraft Establishment, 1965).
Chapter 9 Evolution and Optimization 311
Global Properties of Evolution Processes 314

Chapter 10 Evolutionary Algorithms for System Identification 353
An Experimental Investigation of Process Identification by Competitive Evolution 355

Chapter 11 Co-Evolution, Self-Adaptation, and Crossover 361
Simulation of Biological Evolution and Machine Learning: I. Selection of Self-Reproducing Numeric Patterns by Data Processing Machines, Effects of Hereditary Control, Mutation Type and Crossing 364

Chapter 12 Evolving Populations 389
Mathematical Optimization: Are There Abstract Limits on Natural Selection? 391
W. Bossert (Mathematical Challenges to the Neo-Darwinian Interpretation of Evolution, 1967).

Chapter 13 Artificial Ecosystems 403
Evolution Experiments with an Artificial Ecosystem 406

Chapter 14 Soft Selection 423
An Evolutionary Strategy 425
Handicapped Individua in Evolutionary Processes 431
R. Galar (Biological Cybernetics, 1985).

Chapter 15 Schema Processing and the K-Armed Bandit 441
Genetic Algorithms and the Optimal Allocation of Trials 443

Chapter 16 Classifier Systems 461
Cognitive Systems Based on Adaptive Algorithms 464
J. H. Holland and J. S. Reitman (Pattern-Directed Inference Systems, 1978)

Chapter 17 Evolving Neural Networks 481
Computational Modeling of Evolutionary Learning Processes in the Brain 485

Chapter 18 Evolutionary Computation and the Traveling Salesman Problem 523
Alleles, Loci, and the Traveling Salesman Problem 526
Genetic Algorithms for the Traveling Salesman Problem 532

Chapter 19 The Iterated Prisoner's Dilemma 541
The Evolution of Strategies in the Iterated Prisoner's Dilemma 544
R. Axelrod (Genetic Algorithms and Simulated Annealing, 1987).

Chapter 20 Implicit Parallelism and Representations 555
A New Interpretation of Schema Notation that Overturns the Binary Encoding Constraint 558
Chapter 21  Fuzzy Evolution  565
Ocean Feature Recognition Using Genetic Algorithms with Fuzzy Fitness Functions (GA/F3)  568

Chapter 22  Evolving Programs Using Symbolic Expressions  575
Hierarchical Genetic Algorithms Operating on Populations of Computer Programs  578

Chapter 23  Tierra and Emergent Properties  585
An Approach to the Synthesis of Life  587

Epilogue  625

Author Index  627

Subject Index  629

About the Editor  641