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Advances in Learning Automata and Intelligent Optimization

Springer

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Dedication

To my beloved wife, for her love, her invaluable support, her patience, and understanding during the time, it has taken me to complete this book

Javidan

To my family

Mehdi

To my family for their lovely support

Alireza

To my family

Mohammad Reza

Preface

This book is written for computer scientists, graduate students, and researchers studying artificial intelligence, machine learning, reinforcement learning, learning automata techniques, and engineers working on real-world problem-solving in engineering domains. In particular, the reader is assumed already familiar with basic mathematics, statistics, probability, and algorithm. Prior exposure to mathematics, stochastic process, and learning automata is helpful but not necessary. The book in detail describes verities of learning automaton models and their recent developments of applications in solving real-world problems and optimization with detailed mathematical and theoretical perspectives.

This book consists of nine chapters devoted to the theory of learning automata and cellular learning automata models for optimization. Chapter 1 gives a preliminary introduction and an overview of various learning automata models and static and dynamic optimization concepts. Chapter 2 provides a bibliometric analysis of the research studies on learning automata and optimization as a systematic review. Chapter 3 is dedicated to describing the recent hybrid algorithms with the aid of cellular learning automata. Chapter 4 is devoted to learning automata for behavior control in evolutionary computation in local and global optimization. In Chapter 5, applications of a memetic model of learning automata for solving NP-hard problems are discussed. Chapter 6 provides object migration automata for solving graph and network problems. Chapter 7 gives an overview of multi-population methods for dynamic environments. Chapter 8 describes learning automata for online function evaluation management in evolutionary multi-population methods for dynamic optimization problems. Finally, Chapter 9 provides a detailed discussion on function management in multi-population methods with a variable number of populations using a learning automaton approach.

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whenever needed to produce this important scientific work. We hope that readers will share our pleasure to present this book on the theory of learning automata and optimization will find it useful in their research.

Acknowledgment

We are grateful to many people who have contributed to the work presented here and offered critical reviews of prior publication. We thank Springer for its assistance in publishing the book. We are also grateful to our academic supervisor, family, parents, and friends for their love and support.

March 2021

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Abbreviations

ACO	Ant colony optimization
ACPSO	Adaptive cooperative particle swarm optimizer
AFSA-CLA	Artificial fish swarm algorithm based on cellular learning automata
AIS	Artificial immune system
ACLA	Asynchronous cellular learning automata
ADCLA	Asynchronous dynamic cellular learning automata
ACS	Adaptive cuckoo search
BBExpPSO	Exploiting barebones particle swarm optimization
BBPSO	Barebones particle swarm optimization
BCPSO	Basic clustering particle swarm optimizer
BLA	Bayesian learning automata
BOMA-MA	Baldwinian object migration automation-based memetic algorithm
CA	Cellular automata
CADCLA	Closed asynchronous dynamic cellular learning automata
CALA	Continuous action-set learning automata
CARLA	Continuous action-set reinforcement learning automata
CCGA+LA	Learning automata-based co-evolutionary genetic algorithm
CCLA	Cooperative cellular learning automata
CCLA-EC	Cooperative cellular learning automata-based evolutionary computing
CCPSO	Competitive clustering particle swarm optimizer
CCS	Converged chromosomes set
CDE	Crowding-based differential evolution
CI	Computational intelligence
CLA	Cellular learning automata
CLA-AIS	Cellular learning automata-based artificial immune system
CLA-BBPSO	Cellular learning automata-based barebones particle swarm optimization

CLA-BBPSO-R	Cellular learning automata-based barebones PSO with rotated mutations
CLA-DE	Cellular learning automata-based differential evolution
CLA-EC	Cellular learning automata-based evolutionary computing
CLA-EC-EO	Cellular learning automata-based evolutionary computing with extremal optimization
CLA-FA	Cellular learning automata-based firefly algorithm
CLA-PSO	Cellular learning automata-based particle swarm optimization
CLAMA	Cellular learning automata-based memetic algorithm
CLAMS	Cellular learning automata-based multi-swarm
CLA-MPD	Cellular learning automata-based multi-population
CMA	Canonical memetic algorithm
CPSO	Clustering particle swarm optimization
CPSOLA	Cooperative particle swarm optimization based on learning automata
CS	Cuckoo search
DCLA-PSO	Discrete cellular learning automata-based particle swarm optimization
DE	Differential evolution
DGPA	Discrete generalist pursuit algorithm
DICLA	Dynamic irregular cellular learning automata
DLA	Distributed learning automata
DOP	Dynamic optimization problem
DRLA	Dimensionality ranking in learning automata
EA	Evolutionary algorithm
EC	Evolutionary computation
EDA	Estimation of distribution algorithm
EDLA	Extended distributed learning automata
EO	Extremal optimization
EPP	Equipartitioning problem
ES	Evolutionary strategies
FA	Firefly algorithm
FE	Fitness evaluation
FEM	Fitness evaluation management
FALA	Finite action-set learning automata
FLA	Finite learning automata
FSLA	Fixed structure learning automata
GA	Genetic algorithm
GALA	Genetic algorithm based on learning automata
GIP	Graph isomorphism problem
GLA	Game of learning automata
GSA	Gravitational search algorithm
GSA-LA	Gravitational search algorithm based on learning automata
GSO	Group search optimizer
GWO-LA	Gray wolf optimizer based on learning automata

HS	Harmony search
HOMA-MA	Hybrid (Baldwinian–Lamarckian) object migration automaton-based memetic algorithm
HSLA	Hierarchical structure of learning automata
IADE	Individual-based adaptive differential evolution
IAPSO	Independent adaptive particle swarm optimization
ICA-LA	Imperialist competitive-based learning automata
ICLA	Irregular cellular learning automata
ICLA-EC	Irregular cellular learning automata-based evolutionary computing
ISADE	Independent strategy adaptive differential evolution
LA	Learning automaton
LA-AIN	Learning automata-based artificial immune network
LABSO	Brain storm optimization based on learning automata
LACAIS	Learning automata-based cooperative artificial immune system
LADE	Learning automata-based differential evolution
LAHS	Harmony search algorithm based on learning automata
LA-MA	Learning automata-based memetic algorithm
LBA	Learning bee colony
LOMA–MA	Lamarckian object migration automaton-based memetic algorithm
LS	Local search
MP	Multi-population
MPB	Moving peaks benchmark
MCLA	Multi-reinforcement cellular learning automata
M-CLA-PSO	Memetic cellular learning automata-based particle swarm optimization
MLATI	Multi-reinforcement learning automaton type I
MLATII	Multi-reinforcement learning automaton type II
MLATIII	Multi-reinforcement learning automaton type III
MLAMA	Michigan memetic learning automata
MMLA	Multi-reinforcement learning automata
MNLA	Multi-reinforcement N-tuple learning automata
MOLA	Multi-objective learning automata
NCC	Non-converged chromosome
NLA	Network of learning automata
NSGA-II	Non-dominated sorting genetic algorithm II
OE	Offline error
OMA	Object migration automata
OMA-MA	Object migration automaton-based memetic algorithm
OCLA	Open cellular learning automata
PADE	Population-based adaptive differential evolution
PGAM	Parallel genetic algorithms with migration
PGAM-SA	Parallel genetic algorithms with migrations and simulated annealing

PGAM-TS	Parallel genetic algorithms with migrations and Tabu search
PLA	Pursuit learning automata
PSADE	Population strategy adaptive differential evolution
PSO	Particle swarm optimization
PSO-LA	Particle swarm optimization based on learning automata
QPSO	Quantum-behaved particle swarm optimization
RCLA-EC	Recombinative cellular learning automata-based evolutionary computing
RL	Reinforcement learning
RLMPSO	Reinforcement learning-based memetic particle swarm optimizer
SI	Swarm intelligence
SLA	Stochastic learning automata
TS	Tabu search
TDL	Temporal-difference learning
UAPSO	Unified adaptive particle swarm optimization
VALA	Variable-action-set learning automaton
VSLA	Variable structure learning automata
WCLA	Wavefront cellular learning automata
WoS	Web of Science