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Learning Automata Approach for Social Networks

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*To
my lovely wife, Razieh
my beloved and merciful parents,
Mohammad Reza and Nahid
my dear sisters, Saba and Sepinoud
for their love and support*

Alireza Rezvanian

To the memory of my father, Mohsen
Behnaz Moradabadi

To my family
Mina Ghavipour

To my family
Mohammad Mehdi Daliri Khomami

Preface

This book is written for computer engineers, social scientists, and students studying/working on social networks, artificial intelligence, machine learning, reinforcement learning, and learning automata. The book collects recent developments in learning automaton theory in social network analysis applications. The book in detail describes those learning automata models that applied for solving different problems of social network analysis including graph problems, network sampling, community detection, link prediction, trust management, recommender systems, and influence maximization. In each chapter of the book, validation of the learning automata-based methods is presented through theoretical or simulations aspects. The new model of cellular learning automata called waveform cellular learning automata for social network analysis is also introduced in this book. It is shown that due to the distributed characteristics of waveform cellular learning automata, this model successfully applied in link prediction and network sampling. The level of mathematical analysis is well suited within the grasp of the scientists as well as the graduate students from the computer engineering and social science domains. The readers are encouraged to have basic understanding of social network analysis, reinforcement learning, learning automata, and related topics.

This book consists of nine chapters dedicated toward using recent models of learning automata for social network applications. Chapter 1 provides the necessary background about learning automata theory, distributed learning automata, and several models of learning algorithms. Chapter 2 gives a brief introduction about a recent cellular learning automata model named waveform cellular learning automata. Chapter 3 analyzes the research study for learning approach on social network as bibliometric aspect. Chapter 4 is devoted to applications of learning automata in network sampling algorithms. Chapter 5 discusses the learning automata algorithms for community detections. In Chap. 6 link prediction methods using learning automata models are provided. Chapter 7 introduces recent developments in learning automaton theory in social trust management. Recent social recommender systems based on learning automata techniques are reported in Chap. 8. Finally, Chap. 9 provides new methods of influence maximization based on learning automata for information diffusion.

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Abstract

Online social networks such as *Facebook*, *Twitter*, *Instagram*, and *LinkedIn* have provided an appropriate platform for people to interact with each other and disseminate different types of information. Thus, analyzing these networks is increasingly important for discovering behavior patterns of interactions among individuals and evolution of the networks over time, as well as developing algorithms required for meaningful analysis. Due to uncertain, dynamic and time-varying nature of social interactions in online social networks, especially in activity and interaction networks, some properties of networks such as network centralities, trust values, diffusion probabilities and user influences change dynamicity over time. Therefore, it would be difficult to capture the structural and dynamical properties of the network. To deal with this problem, several studies based on learning systems have been presented in the literature to reflect dynamical behavior of social network issues in time. In recent years, learning automaton (LA) as a promising intelligent technique has presented potential solutions for many real network problems and has the advantage of being able to work in unknown, uncertain, complex and dynamic environments.

This book is aimed to survey recent developments in problems of social networks addressed by learning automata theories, which are related to network measures, network sampling, stochastic networks, stochastic graphs, community detection, link prediction, trust management, recommender system, influence maximization and their applications.