The Book Review Column[1]
by Frederic Green

Department of Mathematics and Computer Science
Clark University
Worcester, MA 02465
email: fgreen@clarku.edu

While the approaches are all different, there is at least one thread running through the three books reviewed in this column: the graph, and/or its more complex relative as manifested in the real world, the network:

1. **Words and Graphs,** by Sergey Kitaev and Vadim Lozin. The mathematics connecting two ideas that are more closely related than might at first appear. Review by James V. Rauff.

2. **Network Science**, by Albert-László Barabási. An introduction to a burgeoning and exciting new field. Review by Panos Louridas.

3. **Trends in Computational Social Choice**, edited by Ulle Endriss. This collection of articles is a follow-up to a title reviewed recently in this column. Review by S.V. Nagaraj.

Please let me know if you are interested in reviewing any of the books listed on the subsequent page are available for review.

BOOKS THAT NEED REVIEWERS FOR THE SIGACT NEWS COLUMN

Algorithms

1. *Tractability: Practical approach to Hard Problems*, Edited by Bordeaux, Hamadi, Kohli
2. *Recent progress in the Boolean Domain*, Edited by Bernd Steinbach
3. *Algorithms and Models for Network Data and Link Analysis,* by François Fouss, Marco Saerens, and Masashi Shimbo
4. *Finite Elements: Theory and Algorithms*, by Sahikumaar Ganesan and Lutz Tobiska
5. *Introduction to Property Testing*, by Oded Goldreich.

Programming Languages

1. *Practical Foundations for Programming Languages,* by Robert Harper

Miscellaneous Computer Science

1. *Actual Causality*, by Joseph Y. Halpern
2. *Elements of Causal Inference: Foundations and Learning Algorithms*, by Jonas Peters, Dominik Janzing, and Bernhard Schölkopf.
3. *Elements of Parallel Computing*, by Eric Aubanel
4. *CoCo: The colorful history of Tandy's Underdog Computer* by Boisy Pitre and Bill Loguidice
5. *Introduction to Reversible Computing*, by Kalyan S. Perumalla
6. *A Short Course in Computational Geometry and Topology*, by Herbert Edelsbrunner
7. *Partially Observed Markov Decision Processes,* by Vikram Krishnamurthy
8. *The Power of Networks*, by Christopher G. Brinton and Mung Chiang
9. *Statistical Modeling and Machine Learning for Molecular Biology*, by Alan Moses
10. *Market Design: A Linear Programming Approach to Auctions and Matching,* by Martin Bichler.

Computability, Complexity, Logic

1. *The Foundations of Computability Theory,* by Borut Robič
2. *Models of Computation*, by Roberto Bruni and Ugo Montanari
3. *Proof Analysis: A Contribution to Hilbert's Last Problem* by Negri and Von Plato.
4. *Applied Logic for Computer Scientists: Computational Deduction and Formal Proofs*, by Mauricio Ayala-Rincón and Flávio L.C. de Moura.
5. *Descriptive Complexity, Canonisation, and Definable Graph Structure Theory*, by Martin Grohe.

Cryptography and Security

1. *Cryptography in Constant Parallel Time,* by Benny Appelbaum
2. *Secure Multiparty Computation and Secret Sharing*, Ronald Cramer, Ivan Bjerre Damgård, and Jesper Buus Nielsen
3. *Codes, Cryptography and Curves with Computer Algebra*, Ruud Pellikaan, Xin-Wen Wu, Stanislav Bulygin, and Relinde Jurrius
4. *A Cryptography Primer: Secrets and Promises*, by Philip N. Klein

Combinatorics and Graph Theory

1. *Finite Geometry and Combinatorial Applications*, by Simeon Ball
2. *Introduction to Random Graphs*, by Alan Frieze and Michał Karoński
3. *Erdős –Ko–Rado Theorems: Algebraic Approaches*, by Christopher Godsil and Karen Meagher
4. *Combinatorics, Words and Symbolic Dynamics,* Edited by Valérie Berthé and Michel Rigo

Miscellaneous Mathematics and History

1. *Professor Stewart's Casebook of Mathematical Mysteries* by Ian Stewart
2. *Introduction to Probability*, by David F. Anderson, Timo Seppäläinen, and Benedek Valkó.

Review of[2]
Words and Graphs
by Sergey Kitaev and Vadim Lozin
Springer, 2015
264 Pages, Hardcover, $109.00

Review by
James V. Rauff, jrauff@millikin.edu
Department of Mathematics
Millikin University
Decatur, IL

1 Introduction

Two distinct letters x and y in a word *alternate* if, after deleting all other letters in the word, the resulting word is of the form $xyxy\ldots$ or $yxyx\ldots$. A graph $G = (V, E)$ is *word-representable* if there exists a word w over the alphabet V such that the letters x and y alternate in w if and only if there is an edge connecting x and y in G. If graphs can be represented by words then exciting new possibilities arise for investigating graph properties in terms of the properties of the words that represent them. In addition, words (i.e. strings) would offer an additional way of storing and manipulating graph structures in computation. This textbook is a comprehensive survey of word-representable graphs and the relationships between combinatorics on words and graph properties. The contents are accessible to graph theorists, formal language theorists, computer scientists, and students who have some familiarity with graph theory and words.

2 Summary of Contents

Words and Graphs consists of nine chapters and two appendices. The appendices provide terminology in graph theory and basic results in combinatorics. I'll summarize the main content of the book by chapter.

Chapter 1. This introductory chapter informally introduces word-representable graphs and poses some basic questions that guide the subsequent chapters. Which graphs are word-representable? How can word-representable graphs be characterized? What is the minimum length of a word that represents a given graph? How hard is the decision problem for word-representable graphs? Under what operations is word-representability preserved?

Chapter 2. Hereditary classes of graphs (classes closed under induced subgraphs) is the topic of this chapter. Word-representable graphs form a hereditary class. The purpose of this chapter is to offer up a variety of graphs that will appear later in the text and to present some results on optimal coding of graphs in a hereditary class.

Chapter 3. Word-representable graphs are formally defined in this chapter. It is shown that the graph K_4 and the Petersen graph are both word-representable. It is proven that the class of word-representable graphs is hereditary and that a word-representable graph may be represented by many different words. For example, K_4 (with numbered vertices) is word-representable by the word 1234 and by 123412.

It is natural to investigate the lengths of words representing a graph. A k-word-representable graph is one that is word representable by a k-uniform word (each letter appears exactly k times). A significant result is that a graph is word-representable if and only if it is k-word-representable for some k. Several examples of k-word representable graphs and of graphs that are not word-representable (e.g., wheel graphs of odd order 5 or greater) are given.
An important result reached in this chapter is that the Maximum Clique problem is polynomial solvable on word-representable graphs. Also in this chapter, the authors provide an algorithm for finding a word representing a given tree.

Chapter 4. This chapter introduces semi-transitive orientations of graphs (a technical condition on directed paths in the graph) and reveals that admitting of these orientations is equivalent to word-representability. Also in this chapter is the result that word-representability is NP-complete.

Chapter 5. Various results on word-representable graphs are presented in this chapter. Among these are connections between word-representability and the chromatic number of a graph. It is also shown that Cartesian product and rooted product preserve word-representability. A detailed discussion of word-representability of polyomino triangulations concludes the chapter.

Chapter 6. In this chapter, the authors look at the relationship between word-representable graphs and pattern-avoiding words. The focus of this chapter is 12-representable graphs. A graph G, with numbered vertices, is 12-representable if there is a word w such that the numbers in w have the property that $x < y$ and x precedes y in w if and only if there is no edge connecting x and y in G. Suppose an isolated vertex labelled n is denoted $\{n\}$ and that the complete graph on m vertices has labelled vertices $1, 2, 3, \ldots, m$. We can see that K_4 is 12-represented 4321, $K_3 \cup \{4\}$ is 12-represented by 3214, and $\{1\} \cup \{2\} \cup \{3\}$ is 12-represented by 123. The notion of 12-representability is a case of a more general idea of u-representability of which word-representability is a special case. Several theorems on 12-representability are presented in this chapter. For example, all paths are 12-representable, but cycle graphs of order greater than four are not. All 12-representable graphs are comparability graphs. (A graph is a comparability graph if and only if its edges can be oriented in such a way that an edge from x to y and an edge from y to z imply an edge from x to z.) We also learn in this chapter that the word representing a 12-representable graph requires at most two copies of each letter.

Chapter 7. Having presented the basic definitions and theorems on word-representable graphs, the authors turn to open problems. They provide numerous open problems, including: How many k-word representable graphs are there? Characterize all word-representable planar graphs. Are there constants k and c such that graphs that are k-representable are necessarily c-colorable? A useful section in this chapter offers up suggested techniques for attacking problems in word-representability.

Chapters 8-9. The final two chapters explore interrelations between words and graphs in the literature. Topics include Prüfer sequences encoding trees, permutation graphs, Gray codes, de Bruijn graphs, and finding asymptotics for the snake-in-the-box problem.

3 Opinion

Words and Graphs is an excellent, comprehensive introduction to the field of word-representable graphs and the interrelationships between words and graphs.

All the major results about word-representable graphs are given in Chapters 3-6. Exercises are provided in Chapters 2-6. The exercises, while not extensive, are sufficient in variety and level of difficulty to help the reader understand the basics of word-representability. Of particular value for students, and for instructors mentoring students, are the numerous open problems given by the authors. Because Kitaev and Lozin proceed with such care and clarity in their investigations, one could model their work, perhaps their characterization of 12-representable trees in Chapter 6, as a research program.

Below the level of research, *Words and Graphs* has much to offer the teacher of undergraduates. Words are simple, yet productive, structures in theoretical computer science. They offer another entry into the field for beginners. For example, the authors give an algorithm in Chapter 3 for finding a word representing a tree. This algorithm is straightforward and easily implemented.

Words and Graphs can be a tough read at times, but I think it can serve as an important reference and a nice entry to the fascinating relationship between words and graphs.

Review of[3]
Network Science
by Albert-László Barabási
Cambridge University Press, 2016
456 pages, Hardcover, $59.00

Review by

Panos Louridas louridas@aueb.gr
Department of Management Science and Technology
Athens University of Economics and Business
Athens, Greece

1 Overview

Albert-László Barabási can be credited with bringing network science to the general public. After a series of papers in such heavyweights as *Nature* and *Science*, his book *Linked* gave a popular science account of the field. With *Network Science* he turns his attention to newcomer students who want to start from scratch and go through a wide ranging, yet accessible, introduction.

The explosion of publications and interest in network science makes it easy to forget how new it is. True, the germs of network science were sown many decades back (one can think of the work of Yule and Zipf as early precursors), but it was not until the end of the millennium that scientists from different disciplines, ranging from computer science and mathematics to physics and statistics, started paying attention to what appear to be a set of unifying principles and underlying phenomena. Barabási did not invent the field, but his publications created a lot of buzz in many places; and in a short while, scientists all over were studying power laws, critical phenomena, and networks—not computer networks, just *networks*. (This reviewer remembers the period, when describing a course on network science he had to always add a proviso like "this is not about computer networks"; otherwise students would get the idea that this was about hardcore computer science. The situation has changed somewhat since then.)

Barabási is certainly well suited to offer a tour of his discipline. He can offer a unique first-hand account, which means that he can write not just on the subject, but on the human stories and the scientists behind the subject as well.

The book is lavishly illustrated in a way that brings to mind standard textbooks in mathematics or physics, and less a computer science book, but then again, network science is not computer science. The reader is offered photos, plots, and illustrations in full color in almost every page.

The book also has a nice online companion, which is freely available at,

http://barabasi.com/networksciencebook/.

The companion is not just a morsel to whet the appetite for the actual book. It can be read instead of the printed book, its material being licensed under a Create Commons license, and apart from static illustrations it includes videos that help explain evolving phenomena. That is a brave move, and one that does not make the printed book obsolete, especially this one, which is produced with care. The current review is on the printed version.

2 Summary of Contents

The book is meant as a course textbook, so the **Preface** gives advice on how to use it in the classroom, before proceeding to a behind-the-scenes view of how the book was produced. It then kicks in with **Chapter 0** (no typo), a personal introduction that lays down how Barabási, a young scientist at IBM in the mid 1990s, had the first inklings of network science that made him take the risk and make the jump to what then seemed an uncertain and poorly defined field. The chapter can be read as an interesting aside to the rest of the book; perhaps it can function as an inspiration to young students; perhaps it will put off some readers who would prefer a neutral, impartial treatment.

Chapter 1 is the real introduction to the book, where Barabási outlines the main characteristics of network science and example applications. The chapter is informal and refrains from introducing any underlying notions. It serves as a survey of the wide range of applicability of network science, helping students understand why they should study it. It also takes a cue from Chapter 0 to conclude with the importance of network science in science itself, as evidenced by the number of papers published and the citations accumulated by the top papers in the area. Students should definitely have their interest piqued by now: not only is this a field with practical applications, scientists working there have their voices heard.

After that the readers can then proceed to **Chapter 2**, a brief overview of graph theory. Starting from the bridges of Königsberg, they will learn that networks are really graphs, and how we can represent graphs in a computer. The chapter also includes essential definitions, such as sparsity, weights, bipartite graphs, paths, distances, connectedness, and the clustering coefficient. The chapter also shows how advanced stuff is going to be handled in the book: some of it is included alongside the main text in boxes, while some is given separately at the end of each chapter. That means that this chapter, as indeed most chapters, can be read fairly quickly in one sitting.

Network science really took off with the realisation that real networks are not random; so, in **Chapter 3** we find random networks first, and then we learn that the networks we find in the world do not follow the model proposed by Erdős and Rényi. That prepares the ground for **Chapter 4**, dedicated to the scale-free property. It is here that the reader will find out what is a power law and how this is related to the scale-free nature of networks. The main features of power laws are given, together with how such networks can be generated, although the actual network models will come in the following chapters.

At this particular point in time there has been considerable discussion on how exactly the existence of power laws is established empirically. Recent research has shown that many networks that have been assumed to follow power laws in fact do not, when subjected to rigorous statistical testing. The book, thankfully, does not shirk away from the controversy. Barabási repeats time and again that this is not a simple matter of drawing a line in a plot and seeing whether it fits. Of course, he is firmly on the one side of the power laws argument, but upon leaving the chapter the reader will have appreciated that this is a nuanced situation.

Chapter 5 deals with the preferential attachment model for generating scale-free networks. Also known as the Barabási-Albert model, the model shows that a “the rich get richer” phenomenon can generate networks like the ones we observe in the real world. The model can be traced to the heated argument between Herbert Simon and Benoit Mandelbrot in the 1950s, which is illustrated with gusto. In this chapter the mathematics gets somewhat harder—and not just in the advanced topics section at the end of it; for example, differentials find their way to the main text as well.

As noted in Chapter 4, it is not always straightforward to argue that an observed network follows a power law. The flip side of that is that actual networks may not follow the structure predicted by the Barabási-Albert model. **Chapter 6** deals with extensions to that model that take into account factors such as internal links, aging, the deletion of nodes and links, or accelerated growth. Such extensions are offerred to explain the differences between, say, the network of web documents and the network of scientific publications. This is also the place to introduce the link between networks and the Bose-Einstein condensation. The underlying theory may get tougher; at the same time, the parallels between networks and physics strengthen the main argument of the book on network science as a unifying theory.

Chapter 7 moves on to the exploration of degree correlations, an apparent puzzle in networks: we find scale-free networks where high-degree nodes tend to connect between themselves, but we also find scale-free networks where high-degree nodes tend to connect with low-degree nodes. The first kind of networks are called *assortative networks*, as their hubs follow a "birds of a feather flock together" logic of assortative mating; while the second kind are called *disassortative networks*, as their hubs mix with nodes that are unlike them. The Internet and social networks are assortative, while the e-mail, the World-Wide Web, the citation, and biological networks are disassortative. The chapter outlines possible mechanisms that can give rise to degree correlations.

One of the more striking images of network science was the cover of the July 27, 2000, issue of *Nature*, bearing the title "Achilles' heel of the Internet". The robustness, or lack thereof, of networks is the subject of **Chapter 8**. That is also something that has captured the popular imagination, as large scale network failures bring to mind images of doom; there is a considerable amount of false wisdom around (example: the Internet was built to withstand nuclear attacks and is therefore impervious to anything—wrong). We know that scale-free networks are vulnerable, if not in the way that random networks are. The chapter treats tolerance to attacks, cascading failures and ways to increase network robustness. The eschatological nature inherent to such discussions is likely to make this chapter particularly appealing to readers; yes, it is sad that we drool over potential catastrophes, but this makes for more purposeful reading. This chapter, and the two that follow, move beyond the mechanisms of scale-free networks to phenomena that appear in them, and can be read largely independently from the preceding ones.

From disasters to how we come together, **Chapter 9** deals with communities in networks. Real world examples are given, from the venerable Zachary's Karate Club to the bilingual division of Belgium (because what brings us together also takes us apart from the other). Several methods for finding communities are given, while the chapter makes a brief, page-long detour to the *P vs. NP* problem, as this chapter is the most algorithmically oriented among the chapters of the book. In fact, for those with more of a computer science than a mathematics or physics background, this chapter may be easier to approach than some of the preceding ones.

The book concludes with an overview of epidemic spreading in networks in **Chapter 10**. We go through epidemic modeling, to network epidemics, to how scale-free networks are relevant to the spread of pathogens (covering sexually transmitted diseases, airborne diseases, as well as digital viruses), immunization, and epidemic prediction. That is a nice way to end the book, as we can see how science can help against morbidity: network science can be a force of good in the world.

There are homework assignments at the ends of the chapters; these may require the students to go over the more theoretical material in the book. In terms of rigor, many concepts are introduced intuitively, and proofs are provided in the advanced topics parts. There is a quantitative gap between the intuitive presentation and the mathematics presented there, but this reflects the nature of network science. The book is not targeted to mathematicians, but neither is it targeted to people who are afraid of formulas.

3 Opinion

The book succeeds as a textbook for network science. As the field has grown, a single book is not enough to cover it; therefore, it would be ideal as a first book on the subject, after which students could move on to other, more advanced texts. Moreover, it is a pleasure to read. The passion of the author for his field is reflected in the book he has written.

Review of[4]
Trends in Computational Social Choice
Edited by
Ulle Endriss
AI Access, 2017
422 pages, Paperback, $22.07
ISBN 9781326912093

Review by
S.V. Nagaraj svnagaraj@acm.org
VIT, Chennai Campus, India

1 Introduction

Social choice theory is an area of economics that studies collective decision making. Examples of collective decision making include sharing a cake or a resource among a group of people or friends, tallying votes in an election, and aggregating opinions of various experts. Computational social choice is a discipline which may be considered to be at the intersection of economics and computer science. This book deals with recent trends related to computational aspects of collective decision making. It contains contributions of experts in computational social choice. The book is divided into three parts that focus on scenarios, techniques, and applications, respectively. It has been published as a sequel to the Handbook of Computational Social Choice, Cambridge University Press, 2016, recently reviewed by me in this column (SIGACT News **48**(4), December 2017, pp. 13-17). Ulle Endriss, the editor of this book, was also an editor of the Handbook. This book has been published by AI Access, a not-for-profit publisher. It is available for free online at the URL http://research.illc.uva.nl/COST-IC1205/Book/, and the hard copy is very nominally priced. The book's publication was supported by COST (European Cooperation in Science and Technology), an EU-funded program.

2 Summary

The book consists of three parts comprising twenty chapters in all. The first part looks at scenarios for which methods involving collective decision making are appropriate. The second part discusses several techniques which are helpful in the examination of the scenarios studied in the first part. The third part presents many interesting applications that illustrate the power of computational social choice. Many chapters have interesting connections with graph theory and networks, briefly highlighted below.

The first part has nine chapters which look beyond the scenarios that have been traditionally studied. Chapter 1 familiarizes the reader with the concept of probabilistic social choice and looks at many recent results in this field. In the context of probabilistic social choice, the outcome of an election may not always produce a winning alternative. However, randomness may be helpful in guaranteeing some fundamental fairness properties. Chapter 2 looks at the interesting topic of multi-winner voting. In this case, the outcome of an election produces a set of winning alternatives instead of just a single winning alternative. There are many practical applications of multi-winner voting, for example, shortlisting job applicants or electing a parliament.

The problem of allocating parliamentary seats to political parties proportionate to the vote share of the parties is an amusing problem of practical significance. Chapter 3 is devoted to a review of several algorithmic methods for this problem, which is related to multi-winner voting. This chapter also looks at the problem of creating electoral districts so that no party gets undue advantage. The key problem here can be formulated as a territorial partitioning problem of finding a partition of n units into k districts according to a specific set of criteria, assuming a territory is composed of n elementary units. Many researchers have assumed a graph-theoretic model representing the territory as a connected n-node graph. The problem of partitioning a graph into connected components has been well researched.

Assume a model of voting, where voters have the capability to assess the outcome of an election, and prefer to reply to that outcome by altering their vote. This process, when iterated, brings up many intriguing questions. For example, one may ask if the process would eventually terminate. This type of voting, known as iterative voting, is discussed in Chapter 4. A formulation in terms of graph theory can be mentioned here. A voting rule in game theory parlance is called a game form. It is known that any game induces a directed graph whose vertices are all action profiles (states), and edges are all local improvement steps (better replies).

Consider a scenario in which every member of a group has to vote on many joint activities in which they may wish to be involved. In this case, their preferences are dependent not only on the activities but also on the number of fellow group members opting for a particular activity. This engrossing scenario, which spans voting as well as coalition formation, is looked at in Chapter 5. Some authors have considered a constrained group activity selection problem where the agents are linked through an undirected graph (representing social interactions), and assigning a coalition of agents to an activity is feasible only if this coalition is connected with respect to this graph. In this way one class of group activity selection problem applies to social networks.

The next chapter focuses on the topic of popular matchings. Graph-theoretic definitions of popular matchings are very common. Matching theory concentrates on pairing agents in some socially optimal way. For popular matchings, we wish to find a matching so that no majority of agents would implement a different matching. Bipartite graphs play a vital role in matching. An expanded version of the popular matching problem is to consider graphs with edge or vertex weights and search for the weight-optimal popular solution.

Judgement aggregation is another topic delved into in the book. There are two chapters on aspects related to judgement aggregation. In Chapter 7, the two frameworks of propositional belief merging and judgement aggregation are compared. In addition, in Chapter 8 the strategic behavior of agents in judgement aggregation is studied. The final chapter of this part, Chapter 9, looks at the possibilities for interaction between social choice theory and social network analysis. The author of this chapter studies the effect of social networks on collective choices, social choice mechanisms over networks, and opinion diffusion. Of course, graph-theoretic concepts and techniques play a central role in this chapter.

The second part of the book has six chapters that focus on techniques for analyzing scenarios of the kind discussed in the first part. In many situations, we may assume that the preferences of agents have some underlying structure. Chapter 10 is dedicated solely to structured preferences. Here two classes of graphs (trees and cycles), that allow positive algorithmic and social choice-theoretic results, play an important role. A key observation is that any class of graphs that contains circles would inherit the negative social choice-theoretic results for circles, and any class of graphs that contains trees would inherit the computational hardness results for trees. It is remarked that intuition could be found by adapting structural concepts from graph theory, such as restrictions resembling tree-width.

Chapter 11 offers an exciting introduction to the application of parameterized complexity for problems of computational social choice. The key idea behind parameterized complexity theory is that the computational intractability of a problem is primarily due to some specific parameters. If these parameters could somehow be made relatively small then it may be feasible to come up with practical algorithms. Parameterized complexity theory is a recent area of research related to algorithms and their complexity that has drawn the attention of many researchers. It provides one possible approach to deal with hard problems. In order to exemplify how fixed parameter tractable algorithms may be developed, the authors of this chapter describe the standard vertex cover problem: Given a graph G, a vertex cover is a set S of vertices in G such that each edge of G has at least one endpoint in S. In order to discuss parameterized intractability, the authors look at two hard problems from graph theory: independent sets and cliques.

Chapter 12 concentrates on another approach to tackle hard problems. This is done by means of approximation algorithms. This chapter goes into approximation algorithms and hardness results for fair division of indivisible goods. It illustrates how approximation techniques can be applied to problems involving computational social choice. Finding a fair allocation could be computationally intractable. However, a more regretful situation arises when finding even an approximately fair solution is also intractable. Graph-theoretic models have been used for developing better algorithms here too.

Chapter 13 on computer-aided methods for social choice theory is largely oriented towards computational aspects of social choice theory. This chapter discusses the application of tools for automated reasoning, especially applying satisfiability solvers of propositional logic to problems in computational social choice. They have been used to confirm the truth of existing proofs of theorems in social choice theory and also to aid in the uncovering of new theorems. There has been some recent work relating k-majority digraphs to the hardness of voting, assuming a constant number of voters. Chapter 14 looks at verification of voting rules. This chapter shows how logic-based program verification helps in the formal verification of software implementations of a voting rule. The concluding chapter of this part discusses an online reference library for preference data. This resource provides a wide variety of data for researchers in computational social choice.

The third part of the book is on applications facilitated by recent advances in computational social choice. There are five chapters in this part. Chapter 16 surveys methods adopted by some countries for allocating parliamentary seats to parties on the basis of vote share received by those parties. This study can help in deciding sensible requirements when designing electoral laws. Chapter 17 focuses on large-scale peer-grading systems. Examples where the ideas from this chapter could be applied include massive online open courses. This chapter uses the notion of bundle graphs. Chapter 18 investigates algorithms for matching agents with other agents on the basis of their preferences. There are many situations where the matching concept can be applied to real-life, for example, choosing colleges for students, matching kidney patients to donors, etc. The maximum weight cycle packing problem in directed graphs has application to kidney exchange programs. In practical applications, the algorithmic solutions developed should also take into account the legal and cultural requirements of the country for which they are considered. Chapter 19 is on the placement of teacher trainees in schools. The focus is on Slovakia. The chapter demonstrates that good algorithmic solutions that work well in practice are indeed feasible. However, some problems related to school placement are shown to be NP-complete by providing polynomial transformations from the standard BIPARTITE GRAPH problem, which is known to be NP-complete. The concluding chapter, i.e. Chapter 20, shows that social choice theory can help people to deal with their routine daily problems. This chapter illustrates that it is practicable to use advanced collective decision making methods that have foundations in social choice theory. This is made possible through the user's mobile phone or device itself.

Edge-compressed majority graphs have been used for information visualization in the context of social choice.

3 Opinion

There is not an iota of doubt that computational social choice has practical significance. There is plenty of scope for interaction between computer science and social choice theory. The applications of computational social choice to problems of everyday life are growing rapidly. This book brings out the recent trends in computational social choice in a comprehensible manner. It includes contributed chapters from distinguished researchers in computational social choice The book contains several challenging open problems. Every chapter contains many references for further study and exploration. The chapters are by and large self-contained and they have been written so that they may be read individually. The editor has ensured that the chapters are uniform. A freely downloadable copy of the book is a big plus. Even the hard copy is very reasonably priced. The book should be useful for popularizing computational social choice, its current trends, and for teaching courses related to it. The book will be useful for practitioners, students, and researchers. The book will be a utilitarian supplement to the Handbook mentioned earlier.