Contents

Foreword *page* **xi**
Hervé Moulin
Contributors **xiii**

1 Introduction to Computational Social Choice **1**
Felix Brandt, Vincent Conitzer, Ulle Endriss, Jérôme Lang, and Ariel D. Procaccia
1.1 Computational Social Choice at a Glance 1
1.2 History of Social Choice Theory 2
1.3 Book Outline 9
1.4 Further Topics 13
1.5 Basic Concepts in Theoretical Computer Science 17

Part I Voting

2 Introduction to the Theory of Voting **23**
William S. Zwicker
2.1 Introduction to an Introduction 23
2.2 Social Choice Functions: Plurality, Copeland, and Borda 26
2.3 Axioms I: Anonymity, Neutrality, and the Pareto Property 30
2.4 Voting Rules I: Condorcet Extensions, Scoring Rules, and Run-Offs 33
2.5 An Informational Basis for Voting Rules: Fishburn's Classification 38
2.6 Axioms II: Reinforcement and Monotonicity Properties 39
2.7 Voting Rules II: Kemeny and Dodgson 44
46
51

Handbook of computational social choice
digitalisiert durch:
IDS Luzern

3 Tournament Solutions **57**
Felix Brandt, Markus Brill, and Paul Harrenstein
3.1 Introduction 57
3.2 Preliminaries 58
3.3 Common Tournament Solutions 62
3.4 Strategyproofness and Agenda Implementation 76
3.5 Generalizations to Weak Tournaments 81
3.6 Further Reading 83

4 Weighted Tournament Solutions **85**
Felix Fischer, Olivier Hudry, and Rolf Niedermeier
4.1 Kemeny's Rule 86
4.2 Computing Kemeny Winners and Kemeny Rankings 88
4.3 Further Median Orders 94
4.4 Applications in Rank Aggregation 96
4.5 Other C2 Functions 96

5 Dodgson's Rule and Young's Rule **103**
Ioannis Caragiannis, Edith Hemaspaandra, and Lane A. Hemaspaandra
5.1 Overview 103
5.2 Introduction, Election-System Definitions, and Results Overview 103
5.3 Winner-Problem Complexity 107
5.4 Heuristic Algorithms 113
5.5 The Parameterized Lens 115
5.6 Approximation Algorithms 118
5.7 Bibliography and Further Reading 125

6 Barriers to Manipulation in Voting **127**
Vincent Conitzer and Toby Walsh
6.1 Introduction 127
6.2 Gibbard-Satterthwaite and Its Implications 128
6.3 Noncomputational Avenues around Gibbard-Satterthwaite 129
6.4 Computational Hardness as a Barrier to Manipulation 131
6.5 Can Manipulation Be Hard Most of the Time? 139
6.6 Fully Game-Theoretic Models 142
6.7 Conclusions 144

7 Control and Bribery in Voting **146**
Piotr Faliszewski and Jörg Rothe
7.1 Introduction 146
7.2 Preliminaries 147
149

8 Rationalizations of [illegible]
Edith Elkind and Arkadii Slinko
8.1 Introduction 169
8.2 Consensus-Based Rules 170

8.3 Rules as Maximum Likelihood Estimators 184
8.4 Conclusions and Further Reading 195

9 Voting in Combinatorial Domains 197
Jérôme Lang and Lirong Xia
9.1 Motivations and Classes of Problems 197
9.2 Simultaneous Voting and the Separability Issue 200
9.3 Approaches Based on Completion Principles 204
9.4 Sequential Voting 215
9.5 Concluding Discussion 221

10 Incomplete Information and Communication in Voting 223
Craig Boutilier and Jeffrey S. Rosenschein
10.1 Introduction 223
10.2 Models of Partial Preferences 224
10.3 Solution Concepts with Partial Preferences 227
10.4 Communication and Query Complexity 234
10.5 Preference Elicitation 239
10.6 Voting with an Uncertain Set of Alternatives 244
10.7 Compilation Complexity 247
10.8 Social Choice from a Utilitarian Perspective 250
10.9 Conclusions and Future Directions 256

Part II Fair Allocation

11 Introduction to the Theory of Fair Allocation 261
William Thomson
11.1 Introduction 261
11.2 What Is a Resource Allocation Problem? 263
11.3 Solutions and Rules 268
11.4 A Sample of Results 277
11.5 Conclusion 282

12 Fair Allocation of Indivisible Goods 284
Sylvain Bouveret, Yann Chevaleyre, and Nicolas Maudet
12.1 Preferences for Resource Allocation Problems 286
12.2 The Fairness versus Efficiency Trade-Off 294
12.3 Computing Fair Allocations 298
12.4 Protocols for Fair Allocation 304
12.5 Conclusion 309

13 Cake Cutting Algorithms 311
Ariel D. Procaccia
311
311

13.6 Bibliography and Further Reading

Part III Coalition Formation

14 Matching under Preferences **333**
Bettina Klaus, David F. Manlove, and Francesca Rossi
14.1 Introduction and Discussion of Applications 333
14.2 Two-Sided Preferences 336
14.3 One-Sided Preferences 345
14.4 Concluding Remarks and Further Reading 354

15 Hedonic Games **356**
Haris Aziz and Rahul Savani
15.1 Introduction 356
15.2 Solution Concepts 359
15.3 Preference Restrictions and Game Representations 361
15.4 Algorithms and Computational Complexity 367
15.5 Further Reading 373

16 Weighted Voting Games **377**
Georgios Chalkiadakis and Michael Wooldridge
16.1 Introduction 377
16.2 Basic Definitions 378
16.3 Basic Computational Properties 383
16.4 Voter Weight versus Voter Power 388
16.5 Simple Games and Yes/No Voting Systems 390
16.6 Conclusions 394
16.7 Further Reading 394

Part IV Additional Topics

17 Judgment Aggregation **399**
Ulle Endriss
17.1 Introduction 399
17.2 Basics 402
17.3 Aggregation Rules 407
17.4 Agenda Characterization Results 414
17.5 Related Frameworks 421
17.6 Applications in Computer Science 423
17.7 Bibliographic Notes and Further Reading 424

18 The Axiomatic Approach and the Internet **427**
Moshe Tennenholtz and Aviv Zohar
427

19 Knockout Tournaments
Virginia Vassilevska Williams
19.1 Introduction 453
19.2 Formal Definition and Some Properties 454

19.3 Agenda Control for General Knockout Tournaments 456
19.4 Agenda Control for Balanced Trees Is Easy for Special Instances 463
19.5 Extensions and Further Reading 471

References **475**
Index **529**