

Table of Contents

| | |
|---|-----|
| Preface | V |
| List of Contributors | VII |
| 1 Introduction | |
| <i>U. Brandes and T. Erlebach</i> | 1 |
| 2 Fundamentals | |
| <i>U. Brandes and T. Erlebach</i> | 7 |
| 2.1 Graph Theory | 7 |
| 2.2 Essential Problems and Algorithms | 9 |
| 2.3 Algebraic Graph Theory | 13 |
| 2.4 Probability and Random Walks | 14 |
| 2.5 Chapter Notes | 15 |
| <hr/> | |
| Part I Elements | |
| <hr/> | |
| 3 Centrality Indices | |
| <i>D. Koschützki, K. A. Lehmann, L. Peeters, S. Richter, D. Tenfelde-Podehl, and O. Zlotowski</i> | 16 |
| 3.1 Introductory Examples | 17 |
| 3.2 A Loose Definition | 19 |
| 3.3 Distances and Neighborhoods | 19 |
| 3.4 Shortest Paths | 28 |
| 3.5 Derived Edge Centralities | 34 |
| 3.6 Vitality | 36 |
| 3.7 Current Flow | 40 |
| 3.8 Random Processes | 43 |
| 3.9 Feedback | 46 |
| 3.10 Dealing with Insufficient Connectivity | 56 |
| 3.11 Graph- vs. Vertex-Level Indices | 59 |
| 3.12 Chapter Notes | 60 |

4 Algorithms for Centrality Indices
R. Jacob, D. Koschützki, K. A. Lehmann, L. Peeters, and D. Tenfelde-Podehl 62

4.1 Basic Algorithms 63

4.2 Centrality-Specific Algorithms 67

4.3 Fast Approximation 72

4.4 Dynamic Computation 80

5 Advanced Centrality Concepts
D. Koschützki, K.A. Lehmann, D. Tenfelde-Podehl, and O. Zlotowski 83

5.1 Normalization 84

5.2 Personalization 87

5.3 Four Dimensions of a Centrality Index 92

5.4 Axiomatization 96

5.5 Stability and Sensitivity 104

Part II Groups

6 Local Density
S. Kosub 112

6.1 Perfectly Dense Groups: Cliques 114

6.2 Structurally Dense Groups 126

6.3 Statistically Dense Groups 131

6.4 Chapter Notes 140

7 Connectivity
F. Kammer and H. Täubig 143

7.1 Fundamental Theorems 144

7.2 Introduction to Minimum Cuts 147

7.3 All-Pairs Minimum Cuts 148

7.4 Properties of Minimum Cuts in Undirected Graphs 149

7.5 Cactus Representation of All Minimum Cuts 157

7.6 Flow-Based Connectivity Algorithms 158

7.7 Non-flow-based Algorithms 165

7.8 Basic Algorithms for Components 169

7.9 Chapter Notes 176

8 Clustering
M. Gaertler 178

8.1 Quality Measurements for Clusterings 180

8.2 Clustering Methods 196

8.3 Other Approaches 209

8.4 Chapter Notes 215

9 Role Assignments

| | |
|--|-----|
| <i>J. Lerner</i> | 216 |
| 9.1 Structural Equivalence | 218 |
| 9.2 Regular Equivalence | 223 |
| 9.3 Other Equivalences | 238 |
| 9.4 Graphs with Multiple Relations | 244 |
| 9.5 The Semigroup of a Graph | 246 |
| 9.6 Chapter Notes | 251 |

10 Blockmodels

| | |
|--|-----|
| <i>M. Nunkesser, D. Sawitzki</i> | 253 |
| 10.1 Deterministic Models | 256 |
| 10.2 Stochastic Models | 275 |
| 10.3 Chapter Notes | 290 |

Part III Networks

11 Network Statistics

| | |
|--|-----|
| <i>M. Brinkmeier and T. Schank</i> | 293 |
| 11.1 Degree Statistics | 294 |
| 11.2 Distance Statistics | 295 |
| 11.3 The Number of Shortest Paths | 300 |
| 11.4 Distortion and Routing Costs | 301 |
| 11.5 Clustering Coefficient and Transitivity | 302 |
| 11.6 Network Motifs | 306 |
| 11.7 Types of Network Statistics | 307 |
| 11.8 Chapter Notes | 316 |

12 Network Comparison

| | |
|-------------------------------------|-----|
| <i>M. Baur and M. Benkert</i> | 318 |
| 12.1 Graph Isomorphism | 319 |
| 12.2 Graph Similarity | 332 |
| 12.3 Chapter Notes | 340 |

13 Network Models

| | |
|--|-----|
| <i>N. Baumann and S. Stiller</i> | 341 |
| 13.1 Fundamental Models | 342 |
| 13.2 Global Structure Analysis | 350 |
| 13.3 Further Models of Network Evolution | 364 |
| 13.4 Internet Topology | 368 |
| 13.5 Chapter Notes | 372 |

14 Spectral Analysis

A. Baltz and L. Kliemann 373

14.1 Fundamental Properties 373

14.2 Numerical Methods 385

14.3 Subgraphs and Operations on Graphs 388

14.4 Bounds on Global Statistics 393

14.5 Heuristics for Graph Identification 406

14.6 Chapter Notes 415

15 Robustness and Resilience

G.W. Klau and R. Weiskircher 417

15.1 Worst-Case Connectivity Statistics 417

15.2 Worst-Case Distance Statistics 422

15.3 Average Robustness Statistics 424

15.4 Probabilistic Robustness Statistics 432

15.5 Chapter Notes 435

Bibliography 439

Index 467



<http://www.springer.com/978-3-540-24979-5>

Network Analysis

Methodological Foundations

Brandes, U.; Erlebach, Th. (Eds.)

2005, XII, 472 p., Softcover

ISBN: 978-3-540-24979-5