

Francesco Ricci
Lior Rokach
Bracha Shapira *Editors*

Recommender Systems Handbook

Third Edition



Springer

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Francesco Ricci • Lior Rokach • Bracha Shapira
Editors

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ISBN 978-1-0716-2196-7 ISBN 978-1-0716-2197-4 (eBook)
<https://doi.org/10.1007/978-1-0716-2197-4>

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Dedicated to

our families in appreciation for their patience and support during the preparation of this handbook

and to

all our students in appreciation of their ideas, patience, and stimulus for better understanding the topics covered in this handbook

F.R.
L.R.
B.S.

Preface

Recommender systems are software tools and techniques providing suggestions for items to be of use to a user. The suggestions provided by a recommender system are aimed at supporting their users in various decision-making processes, such as what items to buy, what music to listen, or what news to read. Recommender systems are valuable means for online users to cope with information overload and help them make better choices. They are now one of the most popular applications of artificial intelligence, supporting information discovery on the Web. Several techniques for recommendation generation have been proposed, and during the last two decades, many of them have also been successfully deployed in commercial environments. Nowadays, all the major Internet players adopt recommendation techniques.

Development of recommender systems is a multi-disciplinary effort which involves experts from various fields such as artificial intelligence, human computer interaction, data mining, statistics, decision support systems, marketing, and consumer behavior.

The first two editions of the handbook, which were published 10 and 6 years ago, were extremely well received by the recommender systems community. The positive reception, along with the fast pace of research in recommender systems, motivated us to further update the handbook. This third edition aims at updating the previously presented material and to show new techniques and applications in the field. The Recommender Systems Handbook is now offered in a greatly revised edition; 11 chapters are totally new, and the remaining chapters are updated versions of selected chapters already published in the second edition.

Despite these revisions, the goal of this handbook remains unaltered. It still aims at presenting both fundamental knowledge and more advanced topics by organizing them in a coherent and unified repository of recommender systems major concepts, theories, methods, trends, challenges, and applications. Its informative, factual pages will provide researchers, students, and practitioners in industry with a comprehensive, yet concise and convenient reference source to recommender systems.

The book describes in detail the classical methods as well as extensions and novel approaches that were more recently introduced. It consists of five parts: General

Recommendation Techniques; Special Recommendation Techniques; Value and Impact of Recommender Systems; Human Computer Interaction; and Applications. The first part presents the most popular and fundamental techniques used nowadays for building recommender systems, such as collaborative filtering, semantic-based methods, recommender systems based on implicit feedback, neural networks, and context-aware methods. The second part comprises chapters on more advanced recommendation techniques, such as session-based recommender systems, adversarial machine learning for recommender systems, group recommendation techniques, reciprocal recommenders systems, natural language techniques for recommender systems, and cross-domain approaches to recommender systems. The third part covers a wide perspective on the evaluation of recommender systems with chapters on methods for evaluating recommender systems, their value and impact, the multistakeholder perspective of recommender systems, and the analysis of the fairness, novelty, and diversity in recommender systems. The fourth part contains a few chapters on the human computer dimension of recommender systems, with papers on the role of explanation, the user personality, and how to effectively support individual and group decision with recommender systems. The last part focusses on application in several important areas, such as, food, music, fashion, and multimedia recommendation.

We would like to thank all authors for their valuable contributions. We would like to express gratitude to all the reviewers who generously provided comments on drafts or counsel otherwise. We would like to express our special thanks to Susan Lagerstrom-Fife and staff members of Springer for their kind cooperation throughout the production of this book. Finally, we wish this handbook will contribute to the growth of this subject; we wish the novices a fruitful learning path, and to those more expert, a compelling application of the ideas discussed in this handbook and a fruitful development of this challenging research area.

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February 2022

Contents

| | |
|---|-----|
| Recommender Systems: Techniques, Applications, and Challenges | 1 |
| Francesco Ricci, Lior Rokach, and Bracha Shapira | |
| Part I General Recommendation Techniques | |
| Trust Your Neighbors: A Comprehensive Survey of Neighborhood-Based Methods for Recommender Systems | 39 |
| Athanasios N. Nikolakopoulos, Xia Ning, Christian Desrosiers, and George Karypis | |
| Advances in Collaborative Filtering | 91 |
| Yehuda Koren, Steffen Rendle, and Robert Bell | |
| Item Recommendation from Implicit Feedback | 143 |
| Steffen Rendle | |
| Deep Learning for Recommender Systems | 173 |
| Shuai Zhang, Yi Tay, Lina Yao, Aixin Sun, and Ce Zhang | |
| Context-Aware Recommender Systems: From Foundations to Recent Developments | 211 |
| Gediminas Adomavicius, Konstantin Bauman, Alexander Tuzhilin, and Moshe Unger | |
| Semantics and Content-Based Recommendations | 251 |
| Cataldo Musto, Marco de Gemmis, Pasquale Lops, Fedelucio Narducci, and Giovanni Semeraro | |
| Part II Special Recommendation Techniques | |
| Session-Based Recommender Systems | 301 |
| Dietmar Jannach, Massimo Quadrana, and Paolo Cremonesi | |

| | |
|---|-----|
| Adversarial Recommender Systems: Attack, Defense, and Advances ... | 335 |
| Vito Walter Anelli, Yashar Deldjoo, Tommaso Di Noia, and Felice Antonio Merra | |
| Group Recommender Systems: Beyond Preference Aggregation | 381 |
| Judith Masthoff and Amra Delić | |
| People-to-People Reciprocal Recommenders | 421 |
| Irena Koprinska and Kalina Yacef | |
| Natural Language Processing for Recommender Systems | 447 |
| Oren Sar Shalom, Haggai Roitman, and Pigi Kouki | |
| Design and Evaluation of Cross-Domain Recommender Systems | 485 |
| Maurizio Ferrari Dacrema, Iván Cantador, Ignacio Fernández-Tobías, Shlomo Berkovsky, and Paolo Cremonesi | |
| Part III Value and Impact of Recommender Systems | |
| Value and Impact of Recommender Systems | 519 |
| Dietmar Jannach and Markus Zanker | |
| Evaluating Recommender Systems | 547 |
| Asela Gunawardana, Guy Shani, and Sivan Yogev | |
| Novelty and Diversity in Recommender Systems | 603 |
| Pablo Castells, Neil Hurley, and Saúl Vargas | |
| Multistakeholder Recommender Systems | 647 |
| Himan Abdollahpouri and Robin Burke | |
| Fairness in Recommender Systems | 679 |
| Michael D. Ekstrand, Anubrata Das, Robin Burke, and Fernando Diaz | |
| Part IV Human Computer Interaction | |
| Beyond Explaining Single Item Recommendations | 711 |
| Nava Tintarev and Judith Masthoff | |
| Personality and Recommender Systems | 757 |
| Marko Tkalčič and Li Chen | |
| Individual and Group Decision Making and Recommender Systems | 789 |
| Anthony Jameson, Martijn C. Willemsen, and Alexander Felfernig | |
| Part V Recommender Systems Applications | |
| Social Recommender Systems | 835 |
| Ido Guy | |
| Food Recommender Systems | 871 |
| David Elsweiler, Hanna Hauptmann, and Christoph Trattner | |

Music Recommendation Systems: Techniques, Use Cases, and Challenges 927
Markus Schedl, Peter Knees, Brian McFee, and Dmitry Bogdanov

Multimedia Recommender Systems: Algorithms and Challenges 973
Yashar Deldjoo, Markus Schedl, Balázs Hidasi, Yinwei Wei, and Xiangnan He

Fashion Recommender Systems 1015
Shatha Jaradat, Nima Dokoohaki, Humberto Jesús Corona Pampín, and Reza Shirvany

Index 1057