SpringerBriefs in Applied Sciences and Technology

SpringerBriefs present concise summaries of cutting-edge research and practical applications across a wide spectrum of fields. Featuring compact volumes of 50–125 pages, the series covers a range of content from professional to academic.

Typical publications can be:

- A timely report of state-of-the art methods
- An introduction to or a manual for the application of mathematical or computer techniques
- A bridge between new research results, as published in journal articles
- A snapshot of a hot or emerging topic
- An in-depth case study
- A presentation of core concepts that students must understand in order to make independent contributions

SpringerBriefs are characterized by fast, global electronic dissemination, standard publishing contracts, standardized manuscript preparation and formatting guidelines, and expedited production schedules.

On the one hand, **SpringerBriefs in Applied Sciences and Technology** are devoted to the publication of fundamentals and applications within the different classical engineering disciplines as well as in interdisciplinary fields that recently emerged between these areas. On the other hand, as the boundary separating fundamental research and applied technology is more and more dissolving, this series is particularly open to trans-disciplinary topics between fundamental science and engineering.

Indexed by EI-Compendex, SCOPUS and Springerlink.

More information about this series at http://www.springer.com/series/8884

Tin-Chih Toly Chen · Katsuhiro Honda

Fuzzy Collaborative Forecasting and Clustering

Methodology, System Architecture, and Applications

Springer

Tin-Chih Toly Chen
Department of Industrial Engineering
and Management
National Chiao Tung University
Hsinchu, Taiwan

Katsuhiro Honda
Graduate School of Engineering
Osaka Prefecture University
Sakai, Osaka, Japan

ISSN 2191-530X ISSN 2191-5318 (electronic)
SpringerBriefs in Applied Sciences and Technology
ISBN 978-3-030-22573-5 ISBN 978-3-030-22574-2 (eBook)
https://doi.org/10.1007/978-3-030-22574-2

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Fuzzy systems have been successfully applied to various problems with uncertainty, including clustering, system control, decision making, and forecasting. However, most of these applications are based on a single fuzzy approach/system that is chosen in a subjective way. In addition, with the widespread of Internet applications, dealing with disparate data sources is becoming increasingly popular. Furthermore, due to technical limitations, security or privacy considerations, the integral access to a number of sources is often limited. For these reasons, the concepts of collaborative computing intelligence and collaborative fuzzy modeling have been proposed; the so-called fuzzy collaborative system have been developed. So far, several studies have argued that for certain problems, a fuzzy collaborative intelligence approach is more precise, accurate, efficient, safe, and private than typical approaches. Although there have been some literature about fuzzy collaborative intelligence and systems, considerable room for development still exists in this field. For example, a crisp method or system needs to be fuzzified to meet the requirements of a fuzzy collaborative intelligence method or system; the collaboration among the participating decision makers needs to be facilitated; and the views of, and the results by, the decision makers have to be aggregated.

So far, most existing fuzzy collaboration systems have been used for clustering, filtering, and forecasting. This book is dedicated to two interesting topics in fuzzy collaborative intelligence and systems, i.e., fuzzy collaborative forecasting and fuzzy collaborative clustering. Both fuzzy collaborative forecasting and fuzzy collaborative clustering are major types of fuzzy collaborative intelligence and systems. However, fuzzy collaborative forecasting is supervised learning because the actual value exists, while fuzzy collaborative clustering is unsupervised learning because there is no absolute clustering result.

It is necessary to acquire a general knowledge of the most useful fuzzy collaborative intelligence and systems in order to be able to apply them efficiently in real-life situations. To this end, six chapters have been provided in this book that belongs to the SpringerBriefs in Applied Sciences and Technology series.

Chapter 1 gives the definitions of fuzzy collaborative intelligence and fuzzy collaborative systems. Then, some existing fuzzy intelligence and systems are classified. The operation procedure of a fuzzy collaborative system is also detailed.

Chapter 2 introduces some linear fuzzy collaborative forecasting methods or models. Then, the steps in operating a fuzzy collaborative forecasting system, including collaboration, aggregation, and defuzzification, are detailed. How to assess the effectiveness of a fuzzy collaborative forecasting method and how to measure the quality of collaboration are also discussed.

Chapter 3 introduces several nonlinear fuzzy collaborative forecasting methods. In addition, a special application of nonlinear fuzzy collaborative forecasting, the collaborative fuzzy analytic hierarchy process, is also described in this chapter.

Chapter 4 reviews fuzzy c-Means (FCM) and its variants, which are the fundamental methods for unsupervised data classification. Then, fuzzy co-clustering, that are prevalent in cooccurrence information analysis, is introduced.

Chapter 5 reviews several collaborative clustering models and introduces a collaborative framework of fuzzy co-clustering. Two types of distributed databases, i.e., vertically distributed databases and horizontally distributed databases, can then be handled with different security concepts.

Chapter 6 reviews three-mode fuzzy co-clustering that reveals the intrinsic co-cluster structures from three-mode cooccurrence information. In addition, a framework for securely applying three-mode fuzzy co-clustering is also developed, when cooccurrence information is stored in different organizations.

The purpose of the book is not to be exhaustive in the list of methods and algorithms that exist in the relevant literature. It is intended to provide technical details of the development of fuzzy collaborative intelligence and systems and the corresponding applications. These details will hold great interest for researchers in information engineering, information management, artificial intelligence, and computational intelligence, as well as for practicing managers and engineers.

Hsinchu, Taiwan — Tin-Chih Toly Chen
Sakai, Osaka, Japan — Katsuhiro Honda

Contents