Preface

This book is the outgrowth of our teaching advanced undergraduate and graduate courses over the past 20 years. These courses have been taught to different audiences, including students in electrical and electronics engineering, computer engineering, computer science, and informatics, as well as to an interdisciplinary audience of a graduate course on automation. This experience led us to make the book as self-contained as possible and to address students with different backgrounds. As prerequisitive knowledge, the reader requires only basic calculus, elementary linear algebra, and some probability theory basics. A number of mathematical tools, such as probability and statistics as well as constrained optimization, needed by various chapters, are treated in four Appendices. The book is designed to serve as a text for advanced undergraduate and graduate students, and it can be used for either a one- or a two-semester course. Furthermore, it is intended to be used as a self-study and reference book for research and for the practicing scientist/engineer. This latter audience was also our second incentive for writing this book, due to the involvement of our group in a number of projects related to pattern recognition.

SCOPE AND APPROACH

The goal of the book is to present in a unified way the most widely used techniques and methodologies for pattern recognition tasks. Pattern recognition is in the center of a number of application areas, including image analysis, speech and audio recognition, biometrics, bioinformatics, data mining, and information retrieval. Despite their differences, these areas share, to a large extent, a corpus of techniques that can be used in extracting, from the available data, information related to data categories, important "hidden" patterns, and trends. The emphasis in this book is on the most generic of the methods that are currently available. Having acquired the basic knowledge and understanding, the reader can subsequently move on to more specialized application-dependent techniques, which have been developed and reported in a vast number of research papers.

Each chapter of the book starts with the basics and moves, progressively, to more advanced topics'and reviews up-to-date techniques. We have made an effort to keep a balance between mathematical and descriptive presentation. This is not always an easy task. However, we strongly believe that in a topic such as pattern recognition, trying to bypass mathematics deprives the reader of understanding the essentials behind the methods and also the potential of developing new techniques, which fit the needs of the problem at hand that he or she has to tackle. In pattern recognition, the final adoption of an appropriate technique and algorithm is very much a problem-dependent task. Moreover, according to our experience, teaching pattern recognition is also a good "excuse" for the students to refresh and solidify

some of the mathematical basics they have been taught in earlier years. "Repetitio est mater studiosum."

NEW TO THIS EDITION

The new features of the fourth edition include the following.

- MATLAB codes and computer experiments are given at the end of most chapters.
- More examples and a number of new figures have been included to enhance the readability and pedagogic aspects of the book.
- New sections on some important topics of high current interest have been added, including:
  - Nonlinear dimensionality reduction
  - Nonnegative matrix factorization
  - Relevance feedback
  - Robust regression
  - Semi-supervised learning
  - Spectral clustering
  - Clustering combination techniques

Also, a number of sections have been rewritten in the context of more recent applications in mind.

SUPPLEMENTS TO THE TEXT

Demonstrations based on MATLAB are available for download from the book Web site, www.elsevierdirect.com/9781597492720. Also available are electronic figures from the text and (for instructors only) a solutions manual for the end-of-chapter problems and exercises. The interested reader can download detailed proofs, which in the book necessarily, are sometimes, slightly condensed. PowerPoint presentations are also available covering all chapters of the book.

Our intention is to update the site regularly with more and/or improved versions of the MATLAB demonstrations. Suggestions are always welcome. Also at this Web site a page will be available for typos, which are unavoidable, despite frequent careful reading. The authors would appreciate readers notifying them about any typos found.

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