
Preface

The development of pattern recognition methods on the basis of so-called *Markov models* is tightly coupled to the technological progress in the field of automatic speech recognition. Today, however, Markov chain and hidden Markov models are also applied in many other fields where the task is the modeling and analysis of chronologically organized data as, for example, genetic sequences or handwritten texts. Nevertheless, in monographs, Markov models are almost exclusively treated in the context of automatic speech recognition and not as a general, widely applicable tool of statistical pattern recognition.

In contrast, this book puts the formalism of Markov chain and hidden Markov models at the center of its considerations. With the example of the three main application areas of this technology—namely automatic speech recognition, handwriting recognition, and the analysis of genetic sequences—this book demonstrates which adjustments to the respective application area are necessary and how these are realized in current pattern recognition systems. Besides the treatment of the theoretical foundations of the modeling, this book puts special emphasis on the presentation of algorithmic solutions, which are indispensable for the successful practical application of Markov model technology. Therefore, it addresses researchers and practitioners from the field of pattern recognition as well as graduate students with an appropriate major field of study, who want to devote themselves to speech or handwriting recognition, bioinformatics, or related problems and want to gain a deeper understanding of the application of statistical methods in these areas.

The origins of this book lie in the author's extensive research and development in the field of statistical pattern recognition, which initially led to a German book published by Teubner, Wiesbaden, in 2003. The first edition published by Springer in 2008 was basically a translation of the German version with several updates and modifications addressing an international audience. The current second edition is the result of a thorough revision of the complete text including a number of extensions and additions of material as, for example, a more thorough treatment of the EM algorithm, a description of an efficient approximate Viterbi-training procedure, a theoretical derivation of the perplexity measure, and the treatment of multi-pass decoding based on n -best search. Furthermore, this edition contains a presentation of

Bag-of-Features hidden Markov models—a recent extension of the hidden Markov model formalism developed in the author’s research group.

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