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On Statistics Applied Probability*

Discrete-valued time series are common in practice, but methods for their analysis are not well-known. In recent years, methods have been developed which are specifically designed for the analysis of discrete-valued time series. Hidden Markov and Other

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Models for Discrete-Valued Time Series introduces a new, versatile, and computationally tractable class of models, the "hidden Markov" models. It presents a detailed account of these models, then applies them to data from a wide range of diverse subject areas, including medicine, climatology, and geophysics. This book will be invaluable to researchers and postgraduate and senior undergraduate students in statistics. Researchers and applied statisticians who analyze time series

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data in medicine, animal behavior, hydrology, and sociology will also find this information useful.

Machine learning techniques provide cost-effective alternatives to traditional methods for extracting underlying relationships between information and data and for predicting future events by processing existing information to train models. Efficient Learning Machines explores the major topics of machine learning, including knowledge discovery, classifications, genetic algorithms,

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neural networking, kernel methods, and biologically-inspired techniques. Mariette Awad and Rahul Khanna's synthetic approach weaves together the theoretical exposition, design principles, and practical applications of efficient machine learning. Their experiential emphasis, expressed in their close analysis of sample algorithms throughout the book, aims to equip engineers, students of engineering, and system designers to design and create new and more efficient machine learning systems.

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Readers of Efficient Learning Machines will learn how to recognize and analyze the problems that machine learning technology can solve for them, how to implement and deploy standard solutions to sample problems, and how to design new systems and solutions. Advances in computing performance, storage, memory, unstructured information retrieval, and cloud computing have coevolved with a new generation of machine learning paradigms and big data analytics, which the authors present in the

conceptual context of their traditional precursors. Awad and Khanna explore current developments in the deep learning techniques of deep neural networks, hierarchical temporal memory, and cortical algorithms. Nature suggests sophisticated learning techniques that deploy simple rules to generate highly intelligent and organized behaviors with adaptive, evolutionary, and distributed properties. The authors examine the most popular biologically-inspired algorithms, together with a sample

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application to distributed datacenter management. They also discuss machine learning techniques for addressing problems of multi-objective optimization in which solutions in real-world systems are constrained and evaluated based on how well they perform with respect to multiple objectives in aggregate. Two chapters on support vector machines and their extensions focus on recent improvements to the classification and regression techniques at the core of machine learning.

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An introduction to stochastic processes through the use of R Introduction to Stochastic Processes with R is an accessible and well-balanced presentation of the theory of stochastic processes, with an emphasis on real-world applications of probability theory in the natural and social sciences. The use of simulation, by means of the popular statistical freeware R, makes theoretical results come alive with practical, hands-on demonstrations. Written by a highly-qualified expert in the field, the author presents

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numerous examples from a wide array of disciplines, which are used to illustrate concepts and highlight computational and theoretical results. Developing readers' problem-solving skills and mathematical maturity, Introduction to Stochastic Processes with R features: Over 200 examples and 600 end-of-chapter exercises A tutorial for getting started with R, and appendices that contain review material in probability and matrix algebra Discussions of many timely and interesting supplemental

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topics including Markov chain Monte Carlo, random walk on graphs, card shuffling, Black-Scholes options pricing, applications in biology and genetics, cryptography, martingales, and stochastic calculus

Introductions to mathematics as needed in order to suit readers at many mathematical levels A companion website that includes relevant data files as well as all R code and scripts used throughout the book

Introduction to Stochastic Processes with R is an ideal textbook for an introductory course

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in stochastic processes. The book is aimed at undergraduate and beginning graduate-level students in the science, technology, engineering, and mathematics disciplines. The book is also an excellent reference for applied mathematicians and statisticians who are interested in a review of the topic. Seasonal Hidden Markov Models for Stochastic Time Series with Periodically Varying Characteristics A Test-Driven Approach Hands-On Markov Models with Python

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Latent Markov Models for Longitudinal Data Symbolic Time Series Analysis Using Hidden Markov Models

Prediction of Financial Time Series with Hidden Markov Models [microform]

Since the groundbreaking research of Harry Markowitz into the application of operations research to the optimization of investment portfolios, finance has been one of the most important areas of application of operations research. The use of hidden Markov models (HMMs) has become one of the hottest areas of research for such applications to finance.

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This handbook offers systemic applications of different methodologies that have been used for decision making solutions to the financial problems of global markets. As the follow-up to the authors' Hidden Markov Models in Finance (2007), this offers the latest research developments and applications of HMMs to finance and other related fields. Amongst the fields of quantitative finance and actuarial science that will be covered are: interest rate theory, fixed-income instruments, currency market, annuity and insurance policies with option-embedded features, investment strategies, commodity

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markets, energy, high-frequency trading, credit risk, numerical algorithms, financial econometrics and operational risk. Hidden Markov Models in Finance: Further Developments and Applications, Volume II presents recent applications and case studies in finance and showcases the formulation of emerging potential applications of new research over the book's 11 chapters. This will benefit not only researchers in financial modeling, but also others in fields such as engineering, the physical sciences and social sciences. Ultimately the handbook should prove to be a valuable resource to

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dynamic researchers interested in taking full advantage of the power and versatility of HMMs in accurately and efficiently capturing many of the processes in the financial market.

Presents algorithms for using HMMs and explains the derivation of those algorithms for the dynamical systems community.

Reveals How HMMs Can Be Used as General-Purpose Time Series Models Implements all methods in R Hidden Markov Models for Time Series: An Introduction Using R applies hidden Markov models (HMMs) to a wide range of time series types, from continuous-valued,

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circular, and multivariate series to binary data, bounded and unbounded counts, and categorical observations. It also discusses how to employ the freely available computing environment R to carry out computations for parameter estimation, model selection and checking, decoding, and forecasting.

Illustrates the methodology in action After presenting the simple Poisson HMM, the book covers estimation, forecasting, decoding, prediction, model selection, and Bayesian inference. Through examples and applications, the authors describe how to extend and generalize the basic model so it can be

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applied in a rich variety of situations. They also provide R code for some of the examples, enabling the use of the codes in similar applications. Effectively interpret data using HMMs This book illustrates the wonderful flexibility of HMMs as general-purpose models for time series data. It provides a broad understanding of the models and their uses.

Hidden Markov Models for Time Series

Hidden Markov Models in Time Series, with Applications in Economics

Modeling of Multivariate Time Series Using Hidden Markov Models

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Biological Sequence Analysis
An Introduction Using R

Bayesian Nonparametrics

This book constitutes the refereed proceedings of the 18th European Conference on Machine Learning, ECML 2007, held in Warsaw, Poland, September 2007, jointly with PKDD 2007. The 41 revised full papers and 37 revised short papers presented together with abstracts of four invited talks were carefully reviewed and selected from 592 abstracts submitted both, ECML and PKDD. The papers present a wealth of new results in the area and address all current

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issues in machine learning.

Hidden Markov Models for Time Series: An Introduction Using R, Second Edition illustrates the great flexibility of hidden Markov models (HMMs) as general-purpose models for time series data. The book provides a broad understanding of the models and their uses. After presenting the basic model formulation, the book covers estimation, forecasting, decoding, prediction, model selection, and Bayesian inference for HMMs. Through examples and applications, the authors describe how to extend and generalize the basic model so that it can be applied in

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rich variety of situations. The book demonstrates how HMMs can be applied to a wide range of types of time series: continuous-valued, circular, multivariate, binary, bounded and unbounded counts, and categorical observations. It also discusses how to employ the freely available computing environment R to carry out the computations. Features Presents an accessible overview of HMMs Explores a variety of applications in ecology, finance, epidemiology, climatology, and sociology Includes numerous theoretical and programming exercises Provides most of the analysed data sets online New to the second

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edition A total of five chapters on extensions, including HMMs for longitudinal data, hidden semi-Markov models and models with continuous-valued state process New case studies on animal movement, rainfall occurrence and capture recapture data "

A practical introduction perfect for final-year undergraduate and graduate students without a solid background in linear algebra and calculus.

Tables of Folded-sin X/x Interpolation Coefficients

Introduction to Stochastic Processes with R

Hidden Markov Models in Finance

Statistical Models for Telemetry Data

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Computational Science - ICCS 2020
Applied Probability

Thoughtful Machine Learning with Python

Probabilistic models are becoming increasingly important in analysing the huge amount of data being produced by large-scale DNA-sequencing efforts such as the Human Genome Project. For example, hidden Markov models are used for analysing biological sequences, linguistic-grammar-based probabilistic models for identifying RNA secondary structure, and probabilistic evolutionary models for inferring phylogenies of sequences from different organisms. The book gives a unified, up-to-date and self-contained

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Applied Probability account, with a Bayesian slant, of such methods, and more generally to probabilistic methods of sequence analysis. Written by an interdisciplinary team of authors it aims to be accessible to molecular biologists, computer scientists, and mathematicians with no formal knowledge of the other fields, and at the same time present the state-of-the-art in this new and highly important field.

Drawing on the authors' extensive research in the analysis of categorical longitudinal data, Latent Markov Models for Longitudinal Data focuses on the formulation of latent Markov models and the practical

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Applied Probability

use of these models. Numerous examples illustrate how latent Markov models are used in economics, education, sociology, and other fields. The R and MATLAB® routines used for the examples are available on the authors' website. The book provides you with the essential background on latent variable models, particularly the latent class model. It discusses how the Markov chain model and the latent class model represent a useful paradigm for latent Markov models. The authors illustrate the assumptions of the basic version of the latent Markov model and introduce maximum likelihood estimation through the Expectation

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Maximization algorithm. They also cover constrained versions of the basic latent Markov model, describe the inclusion of the individual covariates, and address the random effects and multilevel extensions of the model. After covering advanced topics, the book concludes with a discussion on Bayesian inference as an alternative to maximum likelihood inference. As longitudinal data become increasingly relevant in many fields, researchers must rely on specific statistical and econometric models tailored to their application. A complete overview of latent Markov models, this book demonstrates how to use the models in three types of analysis: transition

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analysis with measurement errors, analyses that consider unobserved heterogeneity, and finding clusters of units and studying the transition between the clusters. This book presents, in an integrated form, both the analysis and synthesis of three different types of hidden Markov models. Unlike other books on the subject, it is generic and does not focus on a specific theme, e.g. speech processing. Moreover, it presents the translation of hidden Markov models' concepts from the domain of formal mathematics into computer codes using MATLAB®. The unique feature of this book is that the theoretical concepts are first presented using an

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intuition-based approach followed by the description of the fundamental algorithms behind hidden Markov models using MATLAB®. This approach, by means of analysis followed by synthesis, is suitable for those who want to study the subject using a more empirical approach. Key Selling Points: Presents a broad range of concepts related to Hidden Markov Models (HMM), from simple problems to advanced theory Covers the analysis of both continuous and discrete Markov chains Discusses the translation of HMM concepts from the realm of formal mathematics into computer code Offers many examples to supplement mathematical notation

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when explaining new concepts

Prediction of Financial Time Series with Hidden
Markov Models

18th European Conference on Machine Learning,
Warsaw, Poland, September 17-21, 2007, Proceedings

Theory and Implementation using MATLAB®

Machine Learning: ECML 2007

An Introduction Using R, Second Edition

Applications in Computer Vision

*"The thesis presents two Hidden Markov Model
(HMM) based methodologies for the analysis
and prediction of financial time series. Both*

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methodologies are symbolic i.e., the time series is discretized into a sequence of symbols and future symbols are predicted based on the past symbols"--Abstract, leaf iii.

Hidden Markov Models for Time Series: An Introduction Using R, Second Edition illustrates the great flexibility of hidden Markov models (HMMs) as general-purpose models for time series data. The book provides a broad understanding of the models and their uses. After presenting the basic model formulation, the book covers estimation, forecasting, decoding,

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prediction, model selection, and Bayesian inference for HMMs. Through examples and applications, the authors describe how to extend and generalize the basic model so that it can be applied in a rich variety of situations. The book demonstrates how HMMs can be applied to a wide range of types of time series: continuous-valued, circular, multivariate, binary, bounded and unbounded counts, and categorical observations. It also discusses how to employ the freely available computing environment R to carry out the computations. Features Presents an accessible overview of HMMs Explores a variety of

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applications in ecology, finance, epidemiology, climatology, and sociology
Includes numerous theoretical and programming exercises Provides most of the analysed data sets online New to the second edition A total of five chapters on extensions, including HMMs for longitudinal data, hidden semi-Markov models and models with continuous-valued state process New case studies on animal movement, rainfall occurrence and capture-recapture data
Here is a work that adds much to the sum of our knowledge in a key area of science today. It is concerned with the estimation of

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discrete-time semi-Markov and hidden semi-Markov processes. A unique feature of the book is the use of discrete time, especially useful in some specific applications where the time scale is intrinsically discrete. The models presented in the book are specifically adapted to reliability studies and DNA analysis. The book is mainly intended for applied probabilists and statisticians interested in semi-Markov chains theory, reliability and DNA analysis, and for theoretical oriented reliability and bioinformatics engineers.

Hidden Markov Models and Dynamical Systems

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An Introduction to Markov Models

Probabilistic Models of Proteins and Nucleic Acids

Time Series Quality Data Modeling Using Hidden Markov Models

Animal Movement

Markov Models

The seven-volume set LNCS 12137, 12138, 12139, 12140, 12141, 12142, and 12143 constitutes the proceedings of the 20th International Conference on Computational Science, ICCS 2020, held in Amsterdam, The Netherlands, in June 2020.* The total of 101 papers and 248 workshop papers

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presented in this book set were carefully reviewed and selected from 719 submissions (230 submissions to the main track and 489 submissions to the workshops). The papers were organized in topical sections named: Part I: ICCS Main Track Part II: ICCS Main Track Part III: Advances in High-Performance Computational Earth Sciences: Applications and Frameworks; Agent-Based Simulations, Adaptive Algorithms and Solvers; Applications of Computational Methods in Artificial Intelligence and Machine Learning; Biomedical and Bioinformatics Challenges for Computer Science Part IV: Classifier Learning from Difficult Data;

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Complex Social Systems through the Lens of
Computational Science; Computational Health;
Computational Methods for Emerging Problems in
(Dis-)Information Analysis Part V: Computational
Optimization, Modelling and Simulation;
Computational Science in IoT and Smart Systems;
Computer Graphics, Image Processing and Artificial
Intelligence Part VI: Data Driven Computational
Sciences; Machine Learning and Data Assimilation
for Dynamical Systems; Meshfree Methods in
Computational Sciences; Multiscale Modelling and
Simulation; Quantum Computing Workshop Part VII:
Simulations of Flow and Transport: Modeling,

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Algorithms and Computation; Smart Systems: Bringing Together Computer Vision, Sensor Networks and Machine Learning; Software Engineering for Computational Science; Solving Problems with Uncertainties; Teaching Computational Science; UNCertainty QUantification for Computational modeLs *The conference was canceled due to the COVID-19 pandemic.

Time series data analysis is increasingly important due to the massive production of such data through the internet of things, the digitalization of healthcare, and the rise of smart cities. As continuous monitoring and data collection become more

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common, the need for competent time series analysis with both statistical and machine learning techniques will increase. Covering innovations in time series data analysis and use cases from the real world, this practical guide will help you solve the most common data engineering and analysis challenges in time series, using both traditional statistical and modern machine learning techniques. Author Aileen Nielsen offers an accessible, well-rounded introduction to time series in both R and Python that will have data scientists, software engineers, and researchers up and running quickly. You'll get the guidance you need to confidently:

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Find and wrangle time series data Undertake exploratory time series data analysis Store temporal data Simulate time series data Generate and select features for a time series Measure error Forecast and classify time series with machine or deep learning Evaluate accuracy and performance

Markov Models This book will offer you an insight into the Hidden Markov Models as well as the Bayesian Networks. Additionally, by reading this book, you will also learn algorithms such as Markov Chain Sampling. Furthermore, this book will also teach you how Markov Models are very relevant when a decision problem is associated with a risk

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that continues over time, when the timing of occurrences is vital as well as when events occur more than once. This book highlights several applications of Markov Models. Lastly, after purchasing this book, you will need to put in a lot of effort and time for you to reap the maximum benefits. By Downloading This Book Now You Will Discover: Hidden Markov Models Dynamic Bayesian Networks Stepwise Mutations using the Wright Fisher Model Using Normalized Algorithms to Update the Formulas Types of Markov Processes Important Tools used with HMM Machine Learning And much much more! Download this book now and

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learn more about Markov Models!

The Application of Hidden Markov Models in Speech Recognition

Inference in Hidden Markov Models

Application of Hidden Markov and Hidden Semi-Markov Models to Financial Time Series/ Vorgelegt Von Jan Bulla

20th International Conference, Amsterdam, The Netherlands, June 3-5, 2020, Proceedings, Part III Theories, Concepts, and Applications for Engineers and System Designers

Efficient Learning Machines

This book discusses mixture and hidden Markov models

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for modeling behavioral data. Mixture and hidden Markov models are statistical models which are useful when an observed system occupies a number of distinct “regimes” or unobserved (hidden) states. These models are widely used in a variety of fields, including artificial intelligence, biology, finance, and psychology. Hidden Markov models can be viewed as an extension of mixture models, to model transitions between states over time. Covering both mixture and hidden Markov models in a single book allows main concepts and issues to be introduced in the relatively simpler context of mixture models. After a thorough treatment of the theory and practice of mixture modeling, the conceptual leap towards hidden Markov models is relatively

straightforward. This book provides many practical examples illustrating the wide variety of uses of the models. These examples are drawn from our own work in psychology, as well as other areas such as financial time series and climate data. Most examples illustrate the use of the authors' `depmixS4` package, which provides a flexible framework to construct and estimate mixture and hidden Markov models. All examples are fully reproducible and the accompanying `hmmR` package provides all the datasets used, as well as additional functionality. This book is suitable for advanced students and researchers with an applied background.

Hidden Markov Models for Time Series An Introduction

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Hidden Markov Models (HMMs) remains a vibrant area of research in statistics, with many new applications appearing since publication of the first edition.

Speech & Language Processing

Hidden Markov and Other Models for Discrete- valued Time Series

Further Developments and Applications, Volume II

Prediction with Statistics and Machine Learning

Their Use in Reliability and DNA Analysis

Bayesian nonparametrics works - theoretically, computationally. The theory provides highly flexible models

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whose complexity grows appropriately with the amount of data. Computational issues, though challenging, are no longer intractable. All that is needed is an entry point: this intelligent book is the perfect guide to what can seem a forbidding landscape. Tutorial chapters by Ghosal, Lijoi and Prünster, Teh and Jordan, and Dunson advance from theory, to basic models and hierarchical modeling, to applications and implementation, particularly in computer science and biostatistics. These are complemented by companion chapters by the editors and Griffin and Quintana, providing additional models, examining computational issues, identifying future growth areas, and giving links to related topics. This coherent text gives ready access both to underlying principles and to

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state-of-the-art practice. Specific examples are drawn from information retrieval, NLP, machine vision, computational biology, biostatistics, and bioinformatics.

As more applications are found, interest in Hidden Markov Models continues to grow. Following comments and feedback from colleagues, students and other working with Hidden Markov Models the corrected 3rd printing of this volume contains clarifications, improvements and some new material, including results on smoothing for linear Gaussian dynamics. In Chapter 2 the derivation of the basic filters related to the Markov chain are each presented explicitly, rather than as special cases of one general filter. Furthermore, equations for smoothed estimates are given. The dynamics for the Kalman

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filter are derived as special cases of the authors' general results and new expressions for a Kalman smoother are given. The Chapters on the control of Hidden Markov Chains are expanded and clarified. The revised Chapter 4 includes state estimation for discrete time Markov processes and Chapter 12 has a new section on robust control.

Unleash the power of unsupervised machine learning in Hidden Markov Models using TensorFlow, pgmpy, and hmmlearn Key Features Build a variety of Hidden Markov Models (HMM) Create and apply models to any sequence of data to analyze, predict, and extract valuable insights Use natural language processing (NLP) techniques and 2D-HMM model for image segmentation Book Description Hidden

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Markov Model (HMM) is a statistical model based on the Markov chain concept. Hands-On Markov Models with Python helps you get to grips with HMMs and different inference algorithms by working on real-world problems. The hands-on examples explored in the book help you simplify the process flow in machine learning by using Markov model concepts, thereby making it accessible to everyone. Once you've covered the basic concepts of Markov chains, you'll get insights into Markov processes, models, and types with the help of practical examples. After grasping these fundamentals, you'll move on to learning about the different algorithms used in inferences and applying them in state and parameter inference. In addition to this, you'll explore the Bayesian

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approach of inference and learn how to apply it in HMMs. In further chapters, you'll discover how to use HMMs in time series analysis and natural language processing (NLP) using Python. You'll also learn to apply HMM to image processing using 2D-HMM to segment images. Finally, you'll understand how to apply HMM for reinforcement learning (RL) with the help of Q-Learning, and use this technique for single-stock and multi-stock algorithmic trading. By the end of this book, you will have grasped how to build your own Markov and hidden Markov models on complex datasets in order to apply them to projects. What you will learn Explore a balance of both theoretical and practical aspects of HMM Implement HMMs using different datasets in Python using different

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packages Understand multiple inference algorithms and how to select the right algorithm to resolve your problems Develop a Bayesian approach to inference in HMMs Implement HMMs in finance, natural language processing (NLP), and image processing Determine the most likely sequence of hidden states in an HMM using the Viterbi algorithm Who this book is for Hands-On Markov Models with Python is for you if you are a data analyst, data scientist, or machine learning developer and want to enhance your machine learning knowledge and skills. This book will also help you build your own hidden Markov models by applying them to any sequence of data. Basic knowledge of machine learning and the Python programming language is expected to get the most out of the book

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Implement probabilistic models for learning complex data sequences using the Python ecosystem

Hidden Markov Models with Time-continuous Output Behavior

Hidden Markov Models

Mixture and Hidden Markov Models with R Estimation and Control

Bayesian Reasoning and Machine Learning

Gain the confidence you need to apply machine learning in your daily work. With this practical guide, author Matthew Kirk shows you how to integrate and test machine learning algorithms in your code, without the academic subtext. Featuring graphs and

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highlighted code examples throughout, the book features tests with Python's Numpy, Pandas, Scikit-Learn, and SciPy data science libraries. If you're a software engineer or business analyst interested in data science, this book will help you: Reference real-world examples to test each algorithm through engaging, hands-on exercises Apply test-driven development (TDD) to write and run tests before you start coding Explore techniques for improving your machine-learning models with data extraction and feature development Watch out for the risks of machine learning, such as underfitting or overfitting data Work with K-Nearest Neighbors, neural networks, clustering, and other algorithms

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The first unified treatment of time series modelling techniques spanning machine learning, statistics, engineering and computer science.

Hidden Markov models (HMMs) originally emerged in the domain of speech recognition. In recent years, they have attracted growing interest in the area of computer vision as well. This book is a collection of articles on new developments in the theory of HMMs and their application in computer vision. It addresses topics such as handwriting recognition, shape recognition, face and gesture recognition, tracking, and image database retrieval. This book is also published as a special issue of the International Journal of Pattern Recognition and Artificial

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Intelligence (February 2001). Contents: Introduction: A Simple Complex in Artificial Intelligence and Machine Learning (B H Juang)An Introduction to Hidden Markov Models and Bayesian Networks (Z Chahramani)Multi-Lingual Machine Printed OCR (P Natarajan et al.)Using a Statistical Language Model to Improve the Performance of an HMM-Based Cursive Handwriting Recognition System (U-V Marti & H Bunke)A 2-D HMM Method for Offline Handwritten Character Recognition (H-S Park et al.)Data-Driven Design of HMM Topology for Online Handwriting Recognition (J J Lee et al.)Hidden Markov Models for Modeling and Recognizing Gesture Under Variation (A D Wilson & A F Bobick)Sentence Lipreading Using

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Hidden Markov Model with Integrated Grammar (K Yu et al.) Tracking and Surveillance in Wide-Area Spatial Environments Using the Abstract Hidden Markov Model (H H Bui et al.) Shape Tracking and Production Using Hidden Markov Models (T Caelli et al.) An Integrated Approach to Shape and Color-Based Image Retrieval of Rotated Objects Using Hidden Markov Models (S Müller et al.) Readership: Graduate students of computer science, electrical engineering and related fields, as well as researchers at academic and industrial institutions. Keywords: Hidden Markov Models; Gesture Recognition; Bayesian Networks; Optical Character Recognition; Handwriting Character Recognition; Cartography; Shape

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Extraction;Image Feature Extraction.

Practical Time Series Analysis

Semi-Markov Chains and Hidden Semi-Markov Models toward Applications

Bayesian Time Series Models

The Application of Hidden Markov Models in Speech Recognition presents the core architecture of a HMM-based LVCSR system and proceeds to describe the various refinements which are needed to achieve state-of-the-art performance.

This book is a comprehensive treatment

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of inference for hidden Markov models, including both algorithms and statistical theory. Topics range from filtering and smoothing of the hidden Markov chain to parameter estimation, Bayesian methods and estimation of the number of states. In a unified way the book covers both models with finite state spaces and models with continuous state spaces (also called state-space models) requiring approximate simulation-based algorithms that are

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also described in detail. Many examples illustrate the algorithms and theory. This book builds on recent developments to present a self-contained view.

The study of animal movement has always been a key element in ecological science, because it is inherently linked to critical processes that scale from individuals to populations and communities to ecosystems. Rapid improvements in biotelemetry data collection and processing technology

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have given rise to a variety of statistical methods for characterizing animal movement. The book serves as a comprehensive reference for the types of statistical models used to study individual-based animal movement. Animal Movement is an essential reference for wildlife biologists, quantitative ecologists, and statisticians who seek a deeper understanding of modern animal movement models. A wide variety of modeling

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approaches are reconciled in the book using a consistent notation. Models are organized into groups based on how they treat the underlying spatio-temporal process of movement. Connections among approaches are highlighted to allow the reader to form a broader view of animal movement analysis and its associations with traditional spatial and temporal statistical modeling. After an initial overview examining the role that animal movement plays in ecology, a primer on

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spatial and temporal statistics provides a solid foundation for the remainder of the book. Each subsequent chapter outlines a fundamental type of statistical model utilized in the contemporary analysis of telemetry data for animal movement inference. Descriptions begin with basic traditional forms and sequentially build up to general classes of models in each category. Important background and technical details for each class of

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model are provided, including spatial point process models, discrete-time dynamic models, and continuous-time stochastic process models. The book also covers the essential elements for how to accommodate multiple sources of uncertainty, such as location error and latent behavior states. In addition to thorough descriptions of animal movement models, differences and connections are also emphasized to provide a broader perspective of

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