An Introduction To Support Vector Machines And Other Kernel Based Learning Methods

GRANT ELIEZER

Linear Algebra and Optimization for Machine Learning Springer Science & Business Media
Data fusion problems arise frequently in many different fields. This book provides a specific introduction to data fusion problems using support vector machines. In the first part, this book begins with a brief survey of additive models and Rayleigh quotient objectives in machine learning, and then introduces kernel fusion as the additive expansion of support vector machines in the dual problem. The second part presents several novel kernel fusion algorithms and some real applications in supervised and unsupervised learning. The last part of the book substantiates the value of the proposed theories and algorithms in MerKator, an open software to identify disease relevant genes based on the integration of heterogeneous genomic data sources in multiple species. The topics presented in this book are meant for researchers or students who use support vector machines. Several topics addressed in the book may also be interesting to computational biologists who want to tackle data fusion challenges in real applications. The background required of the reader is a good knowledge of data mining, machine learning and linear algebra.

Kernel Methods for Pattern Analysis MIT Press
An overview of the theory and application of kernel classification methods. Linear classifiers in kernel spaces have emerged as a major topic within the field of machine learning. The kernel technique takes the linear classifier—a limited, but well-established and comprehensively studied model—and extends its applicability to a wide range of nonlinear pattern-recognition tasks such as natural language processing, machine vision, and biological sequence analysis. This book provides the first comprehensive overview of both the theory and algorithms of kernel classifiers, including the most recent developments. It begins by describing the major algorithmic advances: kernel perceptron learning, kernel Fisher discriminants, support vector

machines, relevance vector machines, Gaussian processes, and Bayes point machines. Then follows a detailed introduction to learning theory, including VC and PAC-Bayesian theory, data-dependent structural risk minimization, and compression bounds. Throughout, the book emphasizes the interaction between theory and algorithms: how learning algorithms work and why. The book includes many examples, complete pseudo code of the algorithms presented, and an extensive source code library.
Supervised, Semi-supervised, and Unsupervised Learning Cambridge University Press
This book provides a systematic and focused study of the various aspects of twin support vector machines (TWSVM) and related developments for classification and regression. In addition to presenting most of the basic models of TWSVM and twin support vector regression (TWSVR) available in the literature, it also discusses the important and challenging applications of this new machine learning methodology. A chapter on “Additional Topics” has been included to discuss kernel optimization and support tensor machine topics, which are comparatively new but have great potential in applications. It is primarily written for graduate students and researchers in the area of machine learning and related topics in computer science, mathematics, electrical engineering, management science and finance.
Pattern Classification Simon and Schuster
A comprehensive introduction to this recent method for machine learning and data mining.
Computing and Information Sciences Apress
A young girl hears the story of her great-great-great-great-grandfather and his brother who came to the United States to make a better life for themselves helping to build the transcontinental railroad.
An Introduction to Statistical Learning Springer Science & Business Media
Support vector machines (SVMs) are used in a range of applications, including drug design, food quality control, metabolic fingerprint analysis, and microarray data-based cancer classification. While most mathematicians are well-versed in the distinctive features and empirical performance of SVMs, many chemists and biologists are not as familiar with what they are and how they work. Presenting a clear bridge between theory and application, Support Vector Machines and Their Application in Chemistry and Biotechnology provides a thorough description of the mechanism of SVMs from the point of view of chemists and biologists, enabling them to solve difficult problems with the help of these powerful tools. Topics discussed include: Background and key elements of support vector machines and applications in chemistry and biotechnology Elements and algorithms of support vector classification (SVC) and support vector regression (SVR) machines, along with discussion of simulated datasets The kernel function for solving nonlinear problems by using a simple linear transformation method Ensemble learning of support vector machines Applications of support vector machines to near-infrared data Support vector machines and quantitative structure-activity/property relationship (QSAR/QSPR) Quality control of traditional Chinese medicine by means of the chromatography fingerprint technique The use of support vector machines in exploring the biological data produced in OMICS study Beneficial for chemical data analysis and the modeling of complex physic-chemical and biological systems, support vector machines show promise in a myriad of areas. This book enables non-mathematicians to understand the potential of SVMs and utilize them in a host of applications.
Advances in Large Margin Classifiers World Scientific Publishing Company
This book focuses on Least Squares Support Vector Machines (LS-SVMs) which are reformulations to standard SVMs. LS-SVMs are closely related to regularization networks and Gaussian processes but additionally emphasize and exploit primal-dual interpretations from optimization theory. The authors explain the natural links between LS-SVM classifiers and kernel Fisher discriminant analysis. Bayesian inference of LS-SVM models is discussed, together with methods for imposing spareness and employing robust statistics. The framework is further extended towards unsupervised learning by considering PCA analysis and its kernel version as a one-class modelling problem. This leads to new primal-dual support vector machine formulations for kernel PCA and kernel CCA analysis. Furthermore, LS-SVM formulations are given for recurrent networks and control. In general, support vector machines may pose heavy computational challenges for large data sets. For this purpose, a method of fixed size LS-SVM is proposed where the estimation is done in the primal space in relation to a Nystrom sampling with active selection of support vectors. The methods are illustrated with several examples.
Python Data Science Handbook Springer Science & Business Media
Every mathematical discipline goes through three periods of development: the naive, the formal, and the critical. David Hilbert The goal of this book is to explain the principles that made support vector machines (SVMs) a successful modeling and prediction tool for a variety of applications. We try to achieve this by presenting the basic ideas of SVMs together with the latest developments and current research questions in a uni?ed style. In a nutshell, we identify at least three reasons for the success of SVMs: their ability to learn well with only a very small number of free parameters, their robustness against several types of model violations and outliers, and last but not least their computational e?ciency compared with several other methods. Although there are several roots and precursors of SVMs, these methods gained particular momentum during the last 15 years since Vapnik (1995, 1998) published his well-known textbooks on statistical learning theory with aspecialemphasisonsupportvectormachines. Sincethen,the?eldofmachine learninghaswitnessedintenseactivityinthestudyofSVMs,whichhass pread moreandmoretootherdisciplinessuchasstatisticsandmathematics. Thusit seems fair to say that several communities are currently working on support vector machines and on related kernel-based methods. Although there are many interactions between these communities, we think that there is still roomforadditionalfruitfulinteractionandwouldbegladifthistextbook were found helpful in stimulating further research. Many of the results presented in this book have previously been scattered in the journal literature or are still under review. As a consequence, these results have been accessible only to a relativelysmallnumberofspecialists,sometimesprobablyonlytopeo plefrom one community but not the others.
An Introduction to Machine Learning An Introduction to Support Vector Machines and Other Kernel-based Learning Methods
Support Vector Machines: Optimization Based Theory, Algorithms, and Extensions presents an accessible treatment of the two main components of support vector machines (SVMs)-classification problems and regression problems. The book emphasizes the close connection between optimization theory and SVMs since optimization is one of the pillars on which
International Conference, ICT 2010, Kochi, Kerala, India, September 7-9, 2010, Proceedings Springer Science & Business Media
This is the first book treating the fields of supervised, semi-supervised and unsupervised machine learning collectively. The

book presents both the theory and the algorithms for mining huge data sets using support vector machines (SVMs) in an iterative way. It demonstrates how kernel based SVMs can be used for dimensionality reduction and shows the similarities and differences between the two most popular unsupervised techniques.

Efficient Learning Machines Springer

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, 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. 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 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.

Support Vector Machines, Regularization, Optimization, and Beyond Cambridge University Press

Overa period spanning morethana decade,supportvector machines (SVMs) have evolved into a leading machine learning technique. SVMs are being applied to a wide range of problems, including bioinformatics, face rec- nition, text classi?cation and many more. It is fair to say that SVMs are one of the most important methods used for data mining with a wide range of software available to support their application. A signi?cant barrier to the widespread application of support vector machines is the absence of a capability to explain, in a human comprehensible form,either the process by which anSVM arrivesat a speci?c decision/result, or more general, the totality of knowledge embedded in these systems. This lack of a capacity to provide an explanation is an obstacle to a more g- eral acceptance of "back box" machine learning systems. In safety-critical or medical applications, an explanation capability is an absolute requirement. This book provides an introduction and overviewof methods used for rule extractionfrom support vector machines.The ?rst parto?ers an introduction to the topic as well as a summary of current research issues. The second chaptersurveysthe?eldofruleextractionfromSVMs,reviewsareasofcurrent research and introduces an application in the ?nancial ?eld.

Optimization Based Theory, Algorithms, and Extensions Cambridge University Press

Offering a fundamental basis in kernel-based learning theory, this book covers both statistical and algebraic principles. It provides over 30 major theorems for kernel-based supervised and unsupervised learning models. The first of the theorems establishes a condition, arguably necessary and sufficient, for the kernelization of learning models. In addition, several other theorems are devoted to proving mathematical equivalence between seemingly unrelated models. With over 25 closed-form and iterative algorithms, the book provides a step-by-step guide to algorithmic procedures and analysing which factors to consider in tackling a given problem, enabling readers to improve specifically designed learning algorithms, build models for new applications and develop efficient techniques suitable for green machine learning technologies. Numerous real-world examples and over 200 problems, several of which are Matlab-based simulation exercises, make this an essential resource for graduate students and professionals in computer science, electrical and biomedical engineering. Solutions to problems are provided online for instructors.

A Gentle Introduction to Support Vector Machines in Biomedicine CRC Press

Regularization, Optimization, Kernels, and Support Vector Machines offers a snapshot of the current state of the art of large-scale machine learning, providing a single multidisciplinary source for the latest research and advances in regularization, sparsity, compressed sensing, convex and large-scale optimization, kernel methods, and support vector machines. Consisting of 21 chapters authored by leading researchers in machine learning, this comprehensive reference: Covers the relationship between support vector machines (SVMs) and the Lasso Discusses multi-layer SVMs Explores nonparametric feature selection, basis pursuit methods, and robust compressive sensing Describes graph-based regularization methods for single- and multi-task learning Considers regularized methods for dictionary learning and portfolio selection Addresses non-negative matrix factorization Examines low-rank matrix and tensor-based models Presents advanced kernel methods for batch and online machine learning, system identification, domain adaptation, and image processing Tackles large-scale algorithms including conditional gradient methods, (non-convex) proximal techniques, and stochastic gradient descent Regularization, Optimization, Kernels, and Support Vector Machines is ideal for researchers in machine learning, pattern recognition, data mining, signal processing, statistical learning, and related areas.

Models, Extensions and Applications Now Publishers Inc

"Over the last years, kernel methods have established themselves as powerful tools for computer vision researchers as well as for practitioners. In this tutorial, we give an introduction to kernel methods in computer vision from a geometric perspective, introducing not only the ubiquitous support vector machines, but also less known techniques for regression, dimensionality reduction, outlier detection, and clustering. Additionally, we give an outlook on very recent, non-classical techniques for the prediction of structure data, for the estimation of statistical dependency, and for learning the kernel function itself. All methods are illustrated with examples of successful application from the recent computer vision research literature" --Abstract.

Recent Trends CRC Press

This textbook introduces linear algebra and optimization in the context of machine learning. Examples and exercises are provided throughout this text book together with access to a solution's manual. This textbook targets graduate level students and professors in computer science, mathematics and data science. Advanced undergraduate students can also use this textbook. The chapters for this textbook are organized as follows: 1. Linear algebra and its applications: The chapters focus on the basics of linear algebra together with their common applications to singular value decomposition, matrix factorization, similarity matrices (kernel methods), and graph analysis. Numerous machine learning applications have been used as examples, such as spectral clustering, kernel-based classification, and outlier detection. The tight integration of linear algebra methods with examples from machine learning differentiates this book from generic volumes on linear algebra. The focus is clearly on the most relevant aspects of linear algebra for machine learning and to teach readers how to apply these concepts. 2. Optimization and its applications: Much of machine learning is posed as an optimization problem in which we try to maximize the accuracy of regression and classification models. The "parent problem" of optimization-centric machine learning is least-squares regression. Interestingly, this problem arises in both linear algebra and optimization, and is one of the key connecting problems of the two fields. Least-squares regression is also the starting point for support vector machines, logistic regression, and recommender systems. Furthermore, the methods for dimensionality reduction and matrix factorization also require the development of optimization methods. A general view of optimization in computational graphs is discussed together with its applications to back propagation in neural networks. A frequent challenge faced by beginners in machine learning is the extensive background required in linear algebra and optimization. One problem is that the existing linear algebra and optimization courses are not specific to machine learning; therefore, one would typically have to complete more course material than is necessary to pick up machine learning. Furthermore, certain types of ideas and tricks from optimization and linear algebra recur more frequently in machine learning than other application-centric settings. Therefore, there is significant value in developing a view of linear algebra and optimization that is better suited to the specific perspective of machine learning.

Learning, Optimization, Classification, and Application to Social Networks Cambridge University Press

It's time to dispel the myth that machine learning is difficult. Grokking Machine Learning teaches you how to apply ML to your projects using only standard Python code and high school-level math. No specialist knowledge is required to tackle the hands-on exercises using readily available machine learning tools! In Grokking Machine Learning, expert machine learning engineer Luis Serrano introduces the most valuable ML techniques and teaches you how to make them work for you. Practical examples illustrate each new concept to ensure you're grokking as you go. You'll build models for spam detection, language analysis, and image recognition as you lock in each carefully-selected skill. Packed with easy-to-follow Python-based exercises and mini-projects, this book sets you on the path to becoming a machine learning expert. Key Features · Different types of machine learning, including supervised and unsupervised learning · Algorithms for simplifying, classifying, and splitting data · Machine learning packages and tools · Hands-on exercises with fully-explained Python code samples For readers with intermediate programming knowledge in Python or a similar language. About the technology Machine learning is a collection of mathematically-based techniques and algorithms that enable computers to identify patterns and generate predictions from data. This revolutionary data analysis approach is behind everything from recommendation systems to self-driving cars, and is transforming industries from finance to art.

Learning to Classify Text Using Support Vector Machines Springer

A comprehensive introduction to this recent method for machine learning and data mining.

Encyclopedia of Biometrics GRIN Verlag

Support Vector Machines (SVMs) are among the most important recent developments in pattern recognition and statistical machine learning. They have found a great range of applications in various fields including biology and medicine. However, biomedical researchers often experience difficulties grasping both the theory and applications of these important methods because of lack of technical background. The purpose of this book is to introduce SVMs and their extensions and allow biomedical researchers to understand and apply them in real-life research in a very easy manner. The book is to consist of two volumes: theory and methods (Volume 1) and cases studies (Volume 2).The proposed book follows the approach of ?programmed learning? whereby material is presented in short sections called ?frames?. Each frame consists of a very small amount of information to be learned, a multiple choice quiz, and answers to the quiz. The reader can proceed to the next frame only after verifying the correct answers to the current frame.

Advances in Kernel Methods Springer

Class-tested and coherent, this textbook teaches classical and web information retrieval, including web search and the related areas of text classification and text clustering from basic concepts. It gives an up-to-date treatment of all aspects of the design and implementation of systems for gathering, indexing, and searching documents; methods for evaluating systems; and an introduction to the use of machine learning methods on text collections. All the important ideas are explained using examples and figures, making it perfect for introductory courses in information retrieval for advanced undergraduates and graduate students in computer science. Based on feedback from extensive classroom experience, the book has been carefully structured in order to make teaching more natural and effective. Slides and additional exercises (with solutions for lecturers) are also available through the book's supporting website to help course instructors prepare their lectures.

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