

Statistical Pattern Recognition

Statistical pattern recognition is a very active area of study and research, which has seen many advances in recent years. New and emerging applications - such as data mining, web searching, multimedia data retrieval, face recognition, and cursive handwriting recognition - require robust and efficient pattern recognition techniques. Statistical decision making and estimation are regarded as fundamental to the study of pattern recognition. Statistical Pattern Recognition, Second Edition has been fully updated with new methods, applications and references. It provides a comprehensive introduction to this vibrant area - with material drawn from engineering, statistics, computer science and the social sciences - and covers many application areas, such as database design, artificial neural networks, and decision support systems. * Provides a self-contained introduction to statistical pattern recognition. * Each technique described is illustrated by real examples. * Covers Bayesian methods, neural networks, support vector machines,

and unsupervised classification. * Each section concludes with a description of the applications that have been addressed and with further developments of the theory. * Includes background material on dissimilarity, parameter estimation, data, linear algebra and probability. * Features a variety of exercises, from 'open-book' questions to more lengthy projects. The book is aimed primarily at senior undergraduate and graduate students studying statistical pattern recognition, pattern processing, neural networks, and data mining, in both statistics and engineering departments. It is also an excellent source of reference for technical professionals working in advanced information development environments.

Methodologies of Pattern Recognition is a collection of papers that deals with the two approaches to pattern recognition (geometrical and structural), the Robbins-Monro procedures, and the implications of interactive graphic computers for pattern recognition methodology. Some papers describe non-supervised learning in statistical pattern recognition, parallel computation in pattern recognition, and statistical analysis as a

tool to make patterns emerge from data. One paper points out the importance of cluster processing in visual perception in which proximate points of similar brightness values form clusters. At higher levels of mental activity humans are efficient in clumping complex items into clusters. Another paper suggests a recognition method which combines versatility and an efficient noise-proofness in dealing with the two main problems in the field of recognition. These difficulties are the presence of a large variety of observed signals and the presence of interference. One paper reports on a possible feature selection for pattern recognition systems employing the minimization of population entropy. Electronic engineers, physicists, physiologists, psychologists, logicians, mathematicians, and philosophers will find great rewards in reading the above collection.

This paper examines the current status of the statistical pattern recognition by the topics: classification rules, feature extraction, contextual analysis, etc. Important but unsolved problem areas are also explored. The relationship between the

statistical pattern recognition and signal processing is also considered.

About The Book: This book explores the heart of pattern recognition concepts, methods and applications using statistical, syntactic and neural approaches. Divided into four sections, it clearly demonstrates the similarities and differences among the three approaches. The second part deals with the statistical pattern recognition approach, starting with a simple example and finishing with unsupervised learning through clustering. Section three discusses the syntactic approach and explores such topics as the capabilities of string grammars and parsing; higher dimensional representations and graphical approaches. Part four presents an excellent overview of the emerging neural approach including an examination of pattern associations and feedforward nets. Along with examples, each chapter provides the reader with pertinent literature for a more in-depth study of specific topics.

**Econophysics, Bioinformatics, and Pattern Recognition
Artificial Neural Networks and Statistical Pattern Recognition**

Introduction to Pattern Recognition **A Probabilistic Theory of Pattern Recognition**

The 1985 Amsterdam conference brought together researchers active in pattern recognition methodology and the development of practical applications. The first part of the book covers various methodological aspects of image processing, knowledge based and model driven image understanding systems, 3-D reconstruction methods, and application oriented papers. Part II deals with aspects of statistical pattern recognition, the problem of population classification, topics common to both pattern recognition and artificial intelligence.

The many different mathematical techniques used to solve pattern recognition problems may be grouped into two general approaches: the decision-theoretic (or discriminant) approach and the syntactic (or structural) approach. In the decision-theoretic approach, a set of characteristic measurements, called features, are extracted from the patterns. Each pattern is represented by a feature vector, and the recognition of each pattern is usually made by partitioning the feature space. Applications of decision-theoretic approach include character recognition, medical diagnosis, remote sensing, reliability and socio-economics. A relatively new approach is the syntactic approach. In the syntactic approach, each pattern is expressed in terms of a composition of its components. The recognition of a pattern is usually made by analyzing the pattern structure according to a given set of rules. Earlier applications of the syntactic approach include chromosome classification, English character recognition and identification of bubble and spark chamber events. The purpose of this monograph is to provide a summary of the major recent applications of syntactic pattern recognition. After a brief introduction of syntactic pattern

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recognition in Chapter 1, the nine main chapters (Chapters 2-10) can be divided into three parts. The first three chapters concern with the analysis of waveforms using syntactic methods. Some application examples include peak detection and interpretation of electro cardiograms and the recognition of speech patterns. The next five chapters deal with the syntactic recognition of two-dimensional pictorial patterns.

This textbook is about statistical pattern recognition. It is intended as a compendium for undergraduate and graduate students studying the field and is particularly written with the aim of facilitating student learning. The main branches covered are supervised classification, clustering, dimensionality reduction, and regression from a machine learning perspective. The different topics are presented in a concise and easy-to-understand manner.

This book constitutes the proceedings of the Joint IAPR International Workshop on Structural, Syntactic, and Statistical Pattern Recognition, S+SSPR 2018, held in Beijing, China, in August 2018. The 49 papers presented in this volume were carefully reviewed and selected from 750 submissions. They were organized in topical sections named: classification and clustering; deep learning and neural networks; dissimilarity representations and Gaussian processes; semi and fully supervised learning methods; spatio-temporal pattern recognition and shape analysis; structural matching; multimedia analysis and understanding; and graph-theoretic methods.

Statistical Pattern Recognition Using Contextual Information

Discriminant Analysis and Statistical Pattern Recognition

Old and New Connections

Pattern Recognition and Machine Learning

Provides a systematic account of the subject area, concentrating

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on the most recent advances in the field. While the focus is on practical considerations, both theoretical and practical issues are explored. Among the advances covered are: regularized discriminant analysis and bootstrap-based assessment of the performance of a sample-based discriminant rule and extensions of discriminant analysis motivated by problems in statistical image analysis. Includes over 1,200 references in the bibliography.

A self-contained and coherent account of probabilistic techniques, covering: distance measures, kernel rules, nearest neighbour rules, Vapnik-Chervonenkis theory, parametric classification, and feature extraction. Each chapter concludes with problems and exercises to further the readers understanding. Both research workers and graduate students will benefit from this wide-ranging and up-to-date account of a fast-moving field.

This book is concerned with important problems of robust (stable) statistical pattern recognition when hypothetical model assumptions about experimental data are violated (disturbed). Pattern recognition theory is the field of applied

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mathematics in which principles and methods are constructed for classification and identification of objects, phenomena, processes, situations, and signals, i. e. , of objects that can be specified by a finite set of features, or properties characterizing the objects (Mathematical Encyclopedia (1984)). Two stages in development of the mathematical theory of pattern recognition may be observed. At the first stage, until the middle of the 1970s, pattern recognition theory was replenished mainly from adjacent mathematical disciplines: mathematical statistics, functional analysis, discrete mathematics, and information theory. This development stage is characterized by successful solution of pattern recognition problems of different physical nature, but of the simplest form in the sense of used mathematical models. One of the main approaches to solve pattern recognition problems is the statistical approach, which uses stochastic models of feature variables. Under the statistical approach, the first stage of pattern recognition theory development is characterized by the assumption that the probability data model is known exactly or it is estimated from a representative sample of large size with negligible estimation

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errors (Das Gupta, 1973, 1977), (Rey, 1978), (Vasiljev, 1983)). This is the first textbook on pattern recognition to present the Bayesian viewpoint. The book presents approximate inference algorithms that permit fast approximate answers in situations where exact answers are not feasible. It uses graphical models to describe probability distributions when no other books apply graphical models to machine learning. No previous knowledge of pattern recognition or machine learning concepts is assumed. Familiarity with multivariate calculus and basic linear algebra is required, and some experience in the use of probabilities would be helpful though not essential as the book includes a self-contained introduction to basic probability theory.

Joint IAPR International Workshop, S+SSPR 2014, Joensuu, Finland, August 20-22, 2014, Proceedings
PATTERN RECOGNITION: STATISTICAL, STRUCTURAL AND NEURAL APPROACHES

Joint IAPR International Workshop, S+SSPR 2016, Mérida, Mexico, November 29 - December 2, 2016, Proceedings

Joint IAPR International Workshop, S+SSPR 2018, Beijing, China, August 17-19, 2018, Proceedings

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This completely revised second edition presents an introduction to statistical pattern recognition. Pattern recognition in general covers a wide range of problems: it is applied to engineering problems, such as character readers and wave form analysis as well as to brain modeling in biology and psychology. Statistical decision and estimation, which are the main subjects of this book, are regarded as fundamental to the study of pattern recognition. This book is appropriate as a text for introductory courses in pattern recognition and as a reference book for workers in the field. Each chapter contains computer projects as well as exercises.

This monograph explores the close relationship of various well-known pattern recognition problems that have so far been considered independent. These relationships became apparent with the discovery of formal procedures for addressing known problems and their generalisations. The generalised problem formulations were analysed mathematically and unified algorithms were found. The main scientific contribution of this book is the unification of two main streams in pattern recognition - the statistical one and the structural one. The material is presented in the form of ten lectures, each of which concludes with a discussion with a student. It provides new views and numerous original results in their field. Written in an easily accessible style, it introduces the basic building blocks of pattern recognition, demonstrates the beauty and the pitfalls

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of scientific research, and encourages good habits in reading mathematical text. This 1996 book explains the statistical framework for pattern recognition and machine learning, now in paperback.

This is the first text on pattern recognition to present the Bayesian viewpoint, one that has become increasingly popular in the last five years. It presents approximate inference algorithms that permit fast approximate answers in situations where exact answers are not feasible. It provides the first text to use graphical models to describe probability distributions when there are no other books that apply graphical models to machine learning. It is also the first four-color book on pattern recognition. The book is suitable for courses on machine learning, statistics, computer science, signal processing, computer vision, data mining, and bioinformatics. Extensive support is provided for course instructors, including more than 400 exercises, graded according to difficulty. Example solutions for a subset of the exercises are available from the book web site, while solutions for the remainder can be obtained by instructors from the publisher.

Structural, Syntactic, and Statistical Pattern Recognition

Pattern Recognition

Statistical Learning and Pattern Analysis for Image and Video Processing

A Review of Statistical Pattern Recognition

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*Pattern recognition is a scientific discipline that is becoming increasingly important in the age of automation and information handling and retrieval. Patter Recognition, 2e covers the entire spectrum of pattern recognition applications, from image analysis to speech recognition and communications. This book presents cutting-edge material on neural networks, - a set of linked microprocessors that can form associations and uses pattern recognition to "learn" -and enhances student motivation by approaching pattern recognition from the designer's point of view. A direct result of more than 10 years of teaching experience, the text was developed by the authors through use in their own classrooms. *Approaches pattern recognition from the designer's point of view *New edition highlights latest developments in this growing field, including independent components and support vector machines, not available elsewhere *Supplemented by computer examples selected from applications of interest*

The classification of patterns is an important area of research which is central to all pattern recognition fields, including speech, image, robotics, and data analysis. Neural networks have

been used successfully in a number of these fields, but so far their application has been based on a 'black box approach' with no real understanding of how they work. In this book, Sarunas Raudys - an internationally respected researcher in the area - provides an excellent mathematical and applied introduction to how neural network classifiers work and how they should be used. . . .

This volume contains all papers presented at SSPR 2002 and SPR 2002 hosted by the University of Windsor, Windsor, Ontario, Canada, August 6-9, 2002. This was the third time these two workshops were held back-to-back. SSPR was the ninth International Workshop on Structural and Syntactic Pattern Recognition and the SPR was the fourth International Workshop on Statistical Techniques in Pattern Recognition. These workshops have traditionally been held in conjunction with ICPR (International Conference on Pattern Recognition), and are the major events for technical committees TC2 and TC1, respectively, of the International Association of Pattern Recognition (IAPR). The workshops were held in parallel and closely coordinated. This was an attempt to resolve the dilemma of how to deal, in

the light of the progressive specialization of pattern recognition, with the need for narrow-focus workshops without further fragmenting the field and introducing yet another conference that would compete for the time and resources of potential participants. A total of 116 papers were received from many countries with the submission and reviewing processes being carried out separately for each workshop. A total of 45 papers were accepted for oral presentation and 35 for posters. In addition four invited speakers presented informative talks and overviews of their research. They were: Tom Dietterich, Oregon State University, USA Sven Dickinson, the University of Toronto, Canada Edwin Hancock, University of York, UK Anil Jain, Michigan State University, USA SSPR 2002 and SPR 2002 were sponsored by the IAPR and the University of Windsor. This book constitutes the refereed proceedings of the 12th International Workshop on Structural and Syntactic Pattern Recognition, SSPR 2008 and the 7th International Workshop on Statistical Techniques in Pattern Recognition, SPR 2008, held jointly in Orlando, FL, USA, in December 2008 as a satellite event of the 19th International Conference of Pattern

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Recognition, ICPR 2008. The 56 revised full papers and 42 revised poster papers presented together with the abstracts of 4 invited papers were carefully reviewed and selected from 175 submissions. The papers are organized in topical sections on graph-based methods, probabilistic and stochastic structural models for PR, image and video analysis, shape analysis, kernel methods, recognition and classification, applications, ensemble methods, feature selection, density estimation and clustering, computer vision and biometrics, pattern recognition and applications, pattern recognition, as well as feature selection and clustering.

Feature Selection in Statistical Pattern Recognition

Joint IAPR International Workshop, SSPR & SPR 2008, Orlando, USA, December 4-6, 2008. Proceedings

On Statistical Pattern Recognition in Independent Component Analysis Mixture Modelling

Pattern Classification

An accessible and up-to-date treatment featuring the connection between neural networks and statistics A Statistical Approach to Neural Networks for Pattern Recognition presents a statistical

treatment of the Multilayer Perceptron (MLP), which is the most widely used of the neural network models. This book aims to answer questions that arise when statisticians are first confronted with this type of model, such as: How robust is the model to outliers? Could the model be made more robust? Which points will have a high leverage? What are good starting values for the fitting algorithm? Thorough answers to these questions and many more are included, as well as worked examples and selected problems for the reader. Discussions on the use of MLP models with spatial and spectral data are also included. Further treatment of highly important principal aspects of the MLP are provided, such as the robustness of the model in the event of outlying or atypical data; the influence and sensitivity curves of the MLP; why the MLP is a fairly robust model; and modifications to make the MLP more robust. The author also provides clarification of several misconceptions that are prevalent in existing neural network literature. Throughout the book, the MLP model is extended in several directions to show that a statistical modeling approach can make valuable contributions, and further exploration for fitting MLP models is

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made possible via the R and S-PLUS® codes that are available on the book's related Web site. A Statistical Approach to Neural Networks for Pattern Recognition successfully connects logistic regression and linear discriminant analysis, thus making it a critical reference and self-study guide for students and professionals alike in the fields of mathematics, statistics, computer science, and electrical engineering.

The first edition, published in 1973, has become a classic reference in the field. Now with the second edition, readers will find information on key new topics such as neural networks and statistical pattern recognition, the theory of machine learning, and the theory of invariances. Also included are worked examples, comparisons between different methods, extensive graphics, expanded exercises and computer project topics. An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department.

With the growing complexity of pattern recognition related problems being solved using Artificial Neural Networks, many ANN researchers are grappling with design issues such as the size of

the network, the number of training patterns, and performance assessment and bounds. These researchers are continually rediscovering that many learning procedures lack the scaling property; the procedures simply fail, or yield unsatisfactory results when applied to problems of bigger size. Phenomena like these are very familiar to researchers in statistical pattern recognition (SPR), where the curse of dimensionality is a well-known dilemma. Issues related to the training and test sample sizes, feature space dimensionality, and the discriminatory power of different classifier types have all been extensively studied in the SPR literature. It appears however that many ANN researchers looking at pattern recognition problems are not aware of the ties between their field and SPR, and are therefore unable to successfully exploit work that has already been done in SPR. Similarly, many pattern recognition and computer vision researchers do not realize the potential of the ANN approach to solve problems such as feature extraction, segmentation, and object recognition. The present volume is designed as a contribution to the greater interaction between the ANN and SPR research communities.

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This book constitutes the proceedings of the Joint IAPR International Workshop on Structural Syntactic, and Statistical Pattern Recognition, S+SSPR 2016, consisting of the International Workshop on Structural and Syntactic Pattern Recognition SSPR, and the International Workshop on Statistical Techniques in Pattern Recognition, SPR. The 51 full papers presented were carefully reviewed and selected from 68 submissions. They are organized in the following topical sections: dimensionality reduction, manifold learning and embedding methods; dissimilarity representations; graph-theoretic methods; model selection, classification and clustering; semi and fully supervised learning methods; shape analysis; spatio-temporal pattern recognition; structural matching; text and document analysis.

Random Graphs for Statistical Pattern Recognition

Methodologies of Pattern Recognition

An Integrated Approach to Design

Statistical and Neural Classifiers

A natural evolution of statistical signal processing, in connection with the progressive increase in computational power, has been exploiting

higher-order information. Thus, high-order spectral analysis and nonlinear adaptive filtering have received the attention of many researchers. One of the most successful techniques for non-linear processing of data with complex non-Gaussian distributions is the independent component analysis mixture modelling (ICAMM). This thesis defines a novel formalism for pattern recognition and classification based on ICAMM, which unifies a certain number of pattern recognition tasks allowing generalization. The versatile and powerful framework developed in this work can deal with data obtained from quite different areas, such as image processing, impact-echo testing, cultural heritage, hypnograms analysis, web-mining and might therefore be employed to solve many different real-world problems.

A timely convergence of two widely used disciplines Random Graphs for Statistical Pattern Recognition is the first book to address the topic of random graphs as it applies to statistical pattern recognition. Both topics are of vital interest to researchers in various mathematical and statistical fields and have never before been treated together in one book. The use of data random graphs in pattern recognition in

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clustering and classification is discussed, and the applications for both disciplines are enhanced with new tools for the statistical pattern recognition community. New and interesting applications for random graph users are also introduced. This important addition to statistical literature features: Information that previously has been available only through scattered journal articles Practical tools and techniques for a wide range of real-world applications New perspectives on the relationship between pattern recognition and computational geometry Numerous experimental problems to encourage practical applications With its comprehensive coverage of two timely fields, enhanced with many references and real-world examples, *Random Graphs for Statistical Pattern Recognition* is a valuable resource for industry professionals and students alike.

This book provides a unique insight into the latest breakthroughs in a consistent manner, at a level accessible to undergraduates, yet with enough attention to the theory and computation to satisfy the professional researcher. Statistical physics addresses the study and understanding of systems with many degrees of freedom. As such it has a rich and varied history, with applications to thermodynamics,

magnetic phase transitions, and order/disorder transformations, to name just a few. However, the tools of statistical physics can be profitably used to investigate any system with a large number of components. Thus, recent years have seen these methods applied in many unexpected directions, three of which are the main focus of this volume. These applications have been remarkably successful and have enriched the financial, biological, and engineering literature. Although reported in the physics literature, the results tend to be scattered and the underlying unity of the field overlooked.

This is the proceedings of the 11th International Workshop on Structural and Syntactic Pattern Recognition, SSPR 2006 and the 6th International Workshop on Statistical Techniques in Pattern Recognition, SPR 2006, held in Hong Kong, August 2006 alongside the Conference on Pattern Recognition, ICPR 2006. 38 revised full papers and 61 revised poster papers are included, together with 4 invited papers covering image analysis, character recognition, bayesian networks, graph-based methods and more.

Joint IAPR International Workshops, SSPR 2006 and SPR 2006, Hong Kong, China, August 17-19, 2006, Proceedings

Neural Networks for Pattern Recognition

Introduction to Statistical Pattern Recognition

Ten Lectures on Statistical and Structural Pattern Recognition

Why are We Writing This Book? Visual data (graphical, image, video, and visualized data) affect every aspect of modern society. The cheap collection, storage, and transmission of vast amounts of visual data have revolutionized the practice of science, technology, and business. Innovations from various disciplines have been developed and applied to the task of designing intelligent machines that can automatically detect and exploit useful regularities (patterns) in visual data. One such approach to machine intelligence is statistical learning and pattern analysis for visual data. Over the past two decades, rapid advances have been made throughout the field of visual pattern analysis. Some fundamental problems, including perceptual grouping, image segmentation, stereomatching, object detection and recognition, and motion analysis and visual tracking, have become hot research topics and test beds in multiple areas of specialization, including mathematics, neuron-biometry, and cognition. A great diversity of models and algorithms stemming from these disciplines has been proposed. To address the issues of ill-posed problems and uncertainties in visual pattern modeling and computing, researchers

have developed rich toolkits based on pattern analysis theory, harmonic analysis and partial differential equations, geometry and group theory, graph matching, and graph grammars. Among these technologies involved in intelligent visual information processing, statistical learning and pattern analysis is undoubtedly the most popular and important approach, and it is also one of the most rapidly developing fields, with many achievements in recent years. Above all, it provides a unifying theoretical framework for intelligent visual information processing applications.

This book constitutes the proceedings of the Joint IAPR International Workshop on Structural, Syntactic, and Statistical Pattern Recognition, S+SSPR 2014; comprising the International Workshop on Structural and Syntactic Pattern Recognition, SSPR, and the International Workshop on Statistical Techniques in Pattern Recognition, SPR. The total of 25 full papers and 22 poster papers included in this book were carefully reviewed and selected from 78 submissions. They are organized in topical sections named: graph kernels; clustering; graph edit distance; graph models and embedding; discriminant analysis; combining and selecting; joint session; metrics and dissimilarities; applications; partial supervision; and poster session.

Readers will emerge with a rigorous statistical grounding in the theory of

how to construct and train neural networks in pattern recognition' New Scientist

The Wiley-Interscience Paperback Series consists of selected books that have been made more accessible to consumers in an effort to increase global appeal and general circulation. With these new unabridged softcover volumes, Wiley hopes to extend the lives of these works by making them available to future generations of statisticians, mathematicians, and scientists. "For both applied and theoretical statisticians as well as investigators working in the many areas in which relevant use can be made of discriminant techniques, this monograph provides a modern, comprehensive, and systematic account of discriminant analysis, with the focus on the more recent advances in the field." -SciTech Book News ". . . a very useful source of information for any researcher working in discriminant analysis and pattern recognition." -Computational Statistics

Discriminant Analysis and Statistical Pattern Recognition provides a systematic account of the subject. While the focus is on practical considerations, both theoretical and practical issues are explored. Among the advances covered are regularized discriminant analysis and bootstrap-based assessment of the performance of a sample-based discriminant rule, and extensions of discriminant analysis motivated by problems in

statistical image analysis. The accompanying bibliography contains over 1,200 references.

Pattern Recognition in Practice II

Statistical Pattern Recognition Booklet

Joint IAPR International Workshops SSPR 2002 and SPR 2002, Windsor, Ontario, Canada, August 6-9, 2002. Proceedings

Statistical, Structural, Neural, and Fuzzy Logic Approaches

This book is an introduction to pattern recognition, meant for undergraduate and graduate students in computer science and related fields in science and technology. Most of the topics are accompanied by detailed algorithms and real world applications. In addition to statistical and structural approaches, novel topics such as fuzzy pattern recognition and pattern recognition via neural networks are also reviewed. Each topic is followed by several examples solved in detail. The only prerequisites for using this book are a one-semester course in discrete mathematics and a knowledge of the basic preliminaries of calculus, linear algebra and probability theory.

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A review along with criticism of some recent work on nonparametric and sequential rules in statistical pattern recognition is given in this paper. Some new results and directions for future work are also discussed. (Author). From engineering to statistics, from computer science to the social sciences, 'Statistical Pattern Recognition' shows how closely these fields are related in terms of application. Areas such as database design, artificial neural networks and decision support are common to all. The author also examines the more diverse theoretical topics available to the practitioner or researcher, such as outlier detection and model selection, and concludes each section with a description of the wider range of practical applications and the future developments of theoretical techniques. Providing an introduction to statistical pattern theory and techniques that draws on material from a wide range of fields, 'Statistical Pattern Recognition' is a must for all technical professionals wanting to get up to speed on the recent advances in this dynamic subject area.

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Robustness in Statistical Pattern Recognition

New Directions in Statistical Physics

Syntactic Pattern Recognition, Applications

A Statistical Approach to Neural Networks for Pattern
Recognition