Duda, Richard O.; **Hart, Peter E.**; **Stork, David G.**
Pattern classification. 2nd ed. (English) Zbl 0968.68140
Chichester: Wiley-Interscience. xxii, 654 p. (2001).

This book is the second edition of the classical book of same authors [Pattern classification and scene analysis, Wiley-Interscience (1973; Zbl 0277.68056)]. This book gives a systematic overview about the major topics in pattern recognition, based whenever possible on fundamental principles.

Chapter 2 speaks about the Bayesian decision theory which is a fundamental statistical approach to the problem of pattern classification. This approach is based on quantifying the tradeoffs between various classification decisions using probability and the costs that accompany such decisions. In subsequent chapters the problems that arise when the probabilistic structure is not completely known are considered.

Unfortunately, in pattern recognition there is rarely, if ever, this kind of complete knowledge about the probabilistic structure of the problem. One approach to this problem is to use the samples to estimate the unknown probabilities and probability densities, and then use the resulting estimates as if they were the true values. The problem of parameter estimation is a classical one in statistics, and it can be approached in several ways. In Chapter 3 two common and reasonable procedures, namely, maximum-likelihood estimation and Bayesian estimation are considered.

Chapter 4 speaks about nonparametric procedures that can be used with arbitrary distributions and without the assumption that the forms of the underlying densities are known.

In Chapter 5 various procedures for determining discriminant functions, some of which are statistical and some of which are not, are examined.

Chapter 6 is devoted to multilayer nonlinear neural networks – nets with two or more layers of modifiable weights – trained by gradient descent methods such as backpropagation perform a maximum-likelihood estimation of the weight values in the model defined by the network topology.

Learning plays a central role in the construction of pattern classifiers. The general approach is to specify a model having one or more parameters and then estimate their values from training data. In Chapter 7 two general classes of such methods are considered. The first, exemplified by Boltzmann learning, is based on concepts and techniques from physics, specifically statistical mechanics. The second, exemplified by genetic algorithms, is based on concepts from biology, specifically the mathematical theory of evolution.

Chapter 8-10 give an overview about pattern recognition based on feature vectors, the performances of classifiers, and unsupervised learning and clustering.

Basic results and definitions from linear algebra, probability theory, information theory, and computational complexity that serve as the mathematical foundations for pattern recognition are presented in the Appendix.

Summary, bibliographical and historical remarks, problems, computer exercises and bibliography section with some valuable references can be found at the end of every chapter.

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MSC:

68T10	Pattern recognition, speech recognition
62C10	Bayesian problems; characterization of Bayes procedures
92Bxx	Mathematical biology in general
62G99	Nonparametric inference
62H30	Classification and discrimination; cluster analysis (statistical aspects)
68-01	Introductory exposition (textbooks, tutorial papers, etc.) pertaining to computer science
68T05	Learning and adaptive systems in artificial intelligence

Keywords:

pattern recognition; statistical decision