
PREFACE

This text is an introduction to pattern recognition, meant to be used by undergraduate and graduate students in Computer Science as well as in related fields in science and technology. The only prerequisite for using this book is a one semester course in discrete mathematics and knowledge of the basic preliminaries of calculus, linear algebra and probability theory. Since most of the topics covered in this text are accompanied by algorithms and applications which involve a considerable amount of computations, we expect the students to be familiar with at least one programming language. This is eventually a necessity, because to solve any nontrivial problem in pattern recognition, one should be able to program a specific algorithm and run it on a digital computer.

A student who takes a course in pattern recognition is usually motivated by one of the following reasons:

1. The need to fulfill the requirements of a degree program in computer science or engineering.
2. A desire to expand one's horizons of knowledge in a subject which has become tremendously important and useful in recent years.
3. The possibility of successfully adapting the studied algorithms for solving real-world problems in various fields.

Although the book is primarily intended for use by students who qualify for classes (2) and (3), it is also written to be at least partially favored by students who belong to class (1).

The purpose of this manuscript is to present the student with the classical topics in pattern recognition, and illustrate the theory by solving practical problems with emphasis on obtaining intuitive understanding of both the application and the appropriate algorithm. Above all this text is meant to provide the student with sufficient knowledge for relatively independent work in the field. An accumulated teaching experience in Computer Science and Applied Mathematics shows that intuitive understanding of algorithms by the student is almost always a guarantee for the student to successfully repeat, apply and modify these algorithms later.

The first chapter is introductory in nature. It concentrates on the importance and usefulness of pattern recognition in a modern world by discussing real applications from the disciplines of computer science, engineering, biology, medicine, psychology and other related sciences. In the second chapter we discuss the concept of *decision functions* emphasizing the principal function of a pattern recognition system: providing *decisions* related to the class membership of incoming patterns. Prior to the remaining chapters which may be read in a non-sequential order, it is recommended that the student masters the first two chapters as well as Chapter 3 in which we introduce the concept of clustering.

A review of the probabilistic approach to pattern recognition is given in Chapter 4. In Chapter 5 we discuss the problem of feature selection and feature extraction. The interaction between fuzzy logic and pattern classification is presented in Chapter 6. Syntactic pattern recognition is introduced in Chapter 7 and the use of neural networks for pattern classification is presented in Chapter 8.

Even though the material in this volume may be considered to be classical in nature, novel topics such as *fuzzy pattern recognition* and *pattern recognition via neural networks*, which are essentials in any modern text on pattern recognition, present a major portion of this text. However, courses in fuzzy logic and neural networks are not prerequisites, since proper introductions to these subjects are given in this book as well.

The content of this text was successfully tested and modified through the many classes taught by both of us in both Computer Science and Electrical Engineering since the late 1970's.

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