Chapter 14
Artificial Intelligence Algorithms for Classification and Pattern Recognition

Robert Jarušek
University of Ostrava, Czech Republic

Vaclav Kocian
University of Ostrava, Czech Republic

ABSTRACT

Classification tasks can be solved using so-called classifiers. A classifier is a computer based agent which can perform a classification task. There are many computational algorithms that can be utilized for classification purposes. Classifiers can be broadly divided into two categories: rule-based classifiers and computational intelligence based classifiers usually called soft computing. Rule-based classifiers are generally constructed by the designer, where the designer defines rules for the interpretation of detected inputs. This is in contrast to soft-computing based classifiers, where the designer only creates a basic framework for the interpretation of data. The learning or training algorithms within such systems are responsible for the generation of rules for the correct interpretation of data.

INTRODUCTION

Research and development in the field of artificial intelligence have been carried out over several decades, from the 50's of the 20th century, when the term of artificial intelligence began to form (Turing, 1950). As John Searle indicated in the Chinese Room argument (Cole, 2014), it not necessary some intelligence to achieve intelligent behaviour if there are sufficient amount of information available. In the 50's, Alan Turing considered that an artificial intelligence system corresponding to its own definition of intelligent behaviour will be available in 2000 (Turing, 1950). At present, it can be noted that despite the disappointment that followed the euphoria of the 50s, there are successful applications of artificial intelligence systems, although not at such level that Alan Turing imagined. In the field of pattern recognition, which will be the aim of the chapter, it is for example a face or smile detection in a picture,

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which is commonly used in compact digital cameras. On the other hand, for example, we can say that there is much to discover in areas such as speech recognition or text. Lots of old manuscripts are waiting in archives to be digitized. Systems for hand-writing recognition, which could replace a computer keyboard, operate only partially and their massive use has not occurred yet.

OVERVIEW OF CLASSIFICATION AND PATTERN RECOGNITION TECHNIQUES

Classification is one of the most frequently encountered decision making tasks of human activity. A classification problem occurs when an object needs to be assigned into a predefined group or class based on a number of observed attributes related to that object. In general, we can say that each task, the output of which is a value from a finite set, can be considered as a classification task.

The whole issue of classification and pattern recognition lies on the border between computer science, mathematics, and artificial intelligence. Pattern recognition is not just limited to work with 2D images which are scanned optically. The issue is the class of procedures that are used for 1D, 2D and 3D signal processing coming from any sensor. For input values, we can consider all data, regardless of their origin, i.e. text, audio, image, etc. Due to the fact that we work on computer input data, all objects can be presented in a binary form without loss of generality. If we assume that a vector can be formed in a different way than the measurement of values, then image recognition receives much wider significance for practical applications. In the last ten years, there has been an expansion of industrial applications that use both optical sensors and special diagnostic procedures to provide the most appropriate solutions of technical or medical problems. More of this issue has been discussed in (Bishop, 2005), (Bishop, 2006) etc.

Classification tasks can be solved using so-called classifiers. A classifier is a computer based agent which can perform a classification task. There are many computational algorithms that can be utilized for classification purposes. Classifiers can be broadly divided into two categories (Ranawana & Palade, 2006): *rule-based classifiers* and *computational intelligence based classifiers*, usually called soft computing (Zadeh, 1994).

Rule-based classifiers are generally constructed by the designer, where the designer defines rules for the interpretation of detected inputs. In other words, the programmer has to cover all possible combinations of ranges of values of the input vector using decision tables in cooperation with a domain expert.

This is in contrast to soft-computing based classifiers, where the designer only creates a basic framework for the interpretation of data. The learning or training algorithms within such systems are responsible for the generation of rules for the correct interpretation of data. Then the system tries to optimally apply these rules or to deduce rules by which their decision-making will be controlled.

In practice, there are often used soft-computing classifiers that use one or more rule-based method for preprocessing inputs before their own classification. Such classifiers are a combination of both approaches and their activities can be divided into two steps.

- **Selection of Key Features:** At first, input data is preprocessed by an algorithm which extracts the key features from the input objects. This is to eliminate the effect of noise, move, rotation, or damage to enter the classification. For feature extraction, there is no general rule. Their choice is related to a given application and it depends on the type of data, but experience and intuition of the expert play a great role here.
- **Own Classification:** Features extracted from objects are presented to classifier for classification.