

A Study on Pattern Recognition and Applications

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Abstract: - Pattern recognition induces attention coming from cognate fields such as machine learning, computer vision, image processing, text and document analysis and neural networks. In this paper discussion on introduction to Pattern recognition concept, method, application and integration is highlighted. It is closely related to machine learning, and also finds applications in fast emerging areas such as biometrics, bioinformatics, multimedia data analysis and most advanced data science.

I. INTRODUCTION

Pattern recognition techniques are concerned with the theory and algorithms of putting abstract objects into categories e.g., measurements made on physical objects. Categories are known in advance and also there exists techniques to learn the categories (clustering). Methods of pattern recognition are useful in many applications such as information retrieval, data mining, document image analysis and recognition, computational linguistics, forensics, biometrics and bioinformatics.

Pattern recognition (PR) is a branch of machine learning that focuses on the recognition of patterns and regularities in data, although it is in some cases considered to be nearly synonymous with machine learning [1]. Pattern recognition systems are in many cases trained from labelled "training" data (supervised learning), but when no labelled data are available other algorithms can be used to discover previously unknown patterns (unsupervised learning). PR is a subject researching object description and classification method.

Machine learning gives computers the ability to learn without being explicitly programmed. The evolution from the study of pattern recognition, machine learning explores the study and construction of algorithms that can learn from and make predictions on data through building a model from sample inputs[2]. Machine learning is employed in a range of computing tasks where designing and programming explicit algorithms with good performance example applications include email filtering, detection of network intruders or malicious insiders working towards a data breach, optical character recognition (OCR), learning to rank, and computer vision.

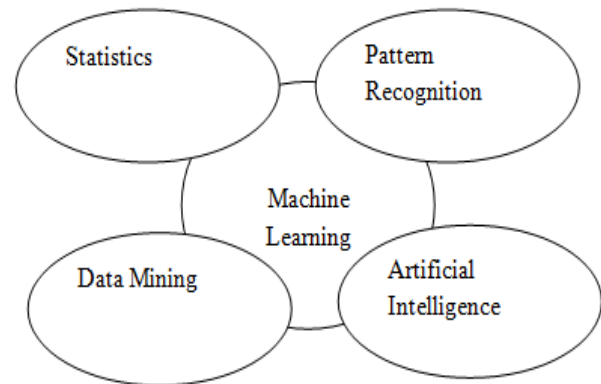


Fig.1. Pattern Recognition and Cognate systems

II. DEFINITION AND APPLICATIONS OF PATTERN RECOGNITION

Pattern recognition is an emerging area since histories we find its application in several fields of engineering and sciences.

2.1 Statistical Pattern Recognition

Statistical Pattern Recognition as defined by Fukunaga (1990) is "A problem of estimating density functions in a high-dimensional space and dividing the space into the regions of categories of classes." [3] Statistical decision and estimation theories have been commonly used in PR based on the feature vector distribution obtained from probability and statistical model. The statistical model is defined by a family of class-conditional probability density functions $Pr(x|c_i)$ (Probability of feature vector x given class c_i) features in some optional order, and then categorized the set of features as a feature vector. [4] Statistical pattern recognition deals with features only without consider the relations between features. Statistical Pattern Recognition applied in new methods and applications such as, Bayesian methods, neural networks, support vector machines, feature selection and feature reduction techniques

2.2 Data Clustering

Data Clustering is considered as the most important unsupervised learning problem. The method of data clustering is partitioned into two classes hierarchical clustering and partition clustering. Clustering deals with finding a structure in a collection of unlabeled data. A cluster is therefore a collection of objects which are "similar" between them and are "dissimilar" to the objects belonging to other clusters [5].

The term data clustering as synonyms like cluster analysis, automatic classification, numerical taxonomy, botrology and typological analysis.

- Marketing: finding groups of customers with similar behavior given a large database of customer data containing their properties and past buying records
- Financial task: Forecasting stock market, currency exchange rate, bank bankruptcies, un-derstanding and managing financial risk, trading futures, credit rating,
- Biology: classification of plants and animals given their features;
- Libraries: book ordering;
- Insurance: identifying groups of motor insurance policy holders with a high average claim cost; identifying frauds;
- City-planning: identifying groups of houses according to their house type, value and geographical location;
- Earthquake studies: clustering observed earthquake epicentres to identify dangerous zones;
- WWW: document classification; clustering web log data to discover groups of similar access patterns

2.3 Fuzzy Sets and Application

In 1966, the application of fuzzy sets in pattern recognition started by Bellan et al.[6], where the two basic operations abstraction and generalization were introduced. The thinking process and the languages of human being is fuzzy and uncertain. In reality, complete answers or classification cannot be obtained so theory of fuzzy sets came into being. Fuzzy sets describe the extension and intension of a concept effectively. The PR system based on fuzzy sets theory can imitate thinking process of human being widely and deeply.

2.4 Neural Networks

Neural networks are data clustering method based on distance measurement. The neural approach applies biological concepts to machines to recognize patterns. The outcome of this effort is the invention of Artificial Neural Networks (ANN) which is set up by the elicitation of the physiology knowledge of human brain. NeurPR is a very attractive since it requires minimum a priori knowledge, and with enough layers and neurons, an ANN can create any complex decision region [7].

2.5 Structural Pattern Recognition

Structural pattern recognition emphasizes on the description of the structure where simple sub-patterns compose one pattern. Where consideration among the relation of each part of the

object is important the structural pattern recognition is best. The two main methods in structural pattern recognition are syntax analysis and structure matching. Syntax analysis formulates its basis in the theory of formal language; the basis of structure matching is some special technique of mathematics based on sub-patterns. Structural pattern recognition handle with symbol information, and it can be used in applications as image interpretation and recognition of multidimensional objects [8]. Syntactic Pattern Recognition a special kind of structural pattern recognition highlights the rules of composition which is customized with recursion. After customizing a series of rules the relation among the parts of the object can be defined [9].

2.6 Applications of Support Vector Machine (SVM) for Pattern Recognition

SVM aims to solve the problems of function estimation based on classification and regression problem and has been applied to a wide range for pattern recognition such as face detection, verification and recognition, object detection and recognition, speech recognition etc [10].

III. PATTERN RECOGNITION SYSTEM

A pattern recognition system based on any PR method mainly includes three mutual-associate and differentiated processes: data building, pattern analysis and pattern classification. Data building convert original information into vector which can be dealt by computer. Pattern analysis task is to process the data (vector), such as feature selection, feature extraction, data-dimension compress and so on. The aim of pattern classification is to utilize the information acquired from pattern analysis to discipline the computer in order to accomplish the classification [11].

The Pattern recognition system is composed of steps such as Pre-processing, Feature Extraction, Classification as shown in fig 2.

Pre-processing is the act of modifying the input data to simplify subsequent operations without losing relevant information.

Examples of pre-processing (for varying types of data) are

- Noise removal.
- Element segmentation;
- Spatial.
- Temporal.
- Alignment or registration of the query to a canonical frame.
- Fixed transformation of the data:

Feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to

better human interpretations. Feature extraction is related to dimensionality reduction.

Classification is a PR problem of assigning an object to a class, the output of the PR system is an integer label, such as classifying a product as “1” or “0” in a quality control test. [12]. A general composition of a PR system is given below.

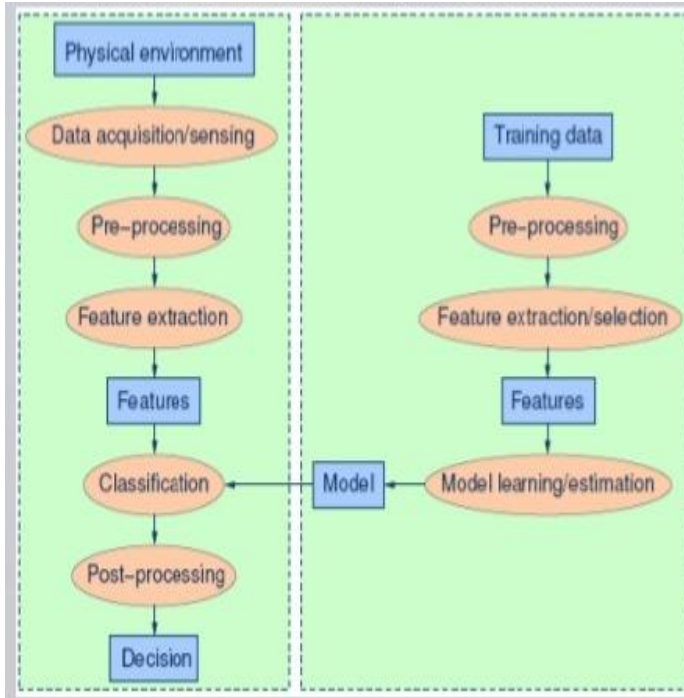


Fig.2. A composition of Pattern Recognition System

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