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A Survey on Pattern Recognition Techniques

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Abstract— Pattern Recognition is a process which recognizes a pattern using a machine or computer. Pattern recognition techniques are concerned with the theory and algorithms of putting abstract objects, e.g., measurements made on physical objects, into categories. Typically the categories are assumed to be known in advance, although there are techniques to learn the categories. Among the various frameworks in which pattern recognition has been traditionally formulated, the statistical approach has been most intensively studied and used in practice. In this paper neural network techniques and methods imported from statistical learning theory that has been receiving increasing attention is discussed which are at the forefront of the exciting and challenging field

Keywords— Pattern Recognition, Statistical pattern recognition, Neural network pattern recognition, applications.

I. INTRODUCTION

A pattern is the description of an object. Pattern recognition can be defined as the categorization of input data into identifiable classes via the extraction of significant features or attributes of the data from a background of irrelevant detail.

The primary goal of pattern recognition is supervised or unsupervised classification: 1) supervised classification in which the input pattern is identified as a member of a predefined class, 2) unsupervised classification in which the pattern is assigned to an unknown class.

The design of a pattern recognition system essentially involves the following three fundamental steps: 1) data acquisition and preprocessing, 2) data representation, and 3) decision making. The problem domain dictates the choice of sensors, preprocessing technique, representation scheme, and the decision making model. Major approaches for pattern recognition are:1) Statistical Pattern Recognition and 2) Neural Pattern Recognition.

II. STATISTICAL PATTERN REOGNITION:

In the statistical approach, each pattern is represented in terms of ‘d’ features or measurements and is viewed as a point in a d-dimensional space. The goal is to choose those features that allow pattern vectors belonging to different categories to occupy compact and disjoint regions in a d-dimensional feature space [1].

The decision making process in statistical pattern recognition can be summarized as follows: A given pattern is to be assigned to one of c categories w1,w1,…,wc based on a vector of d feature values x =(.x1, x2, …, xd). The features are assumed to have a probability density or mass (depending on whether the features are continuous or discrete) function conditioned on the pattern class. Statistical Pattern Recognition employs statistical basis for classification and discrimination of data. A number of characteristic parameters, known as features vectors, are extracted from input data and these feature vectors are used for classification of data. Based on the supervised and unsupervised classification of patterns, there are two kinds of statistical approaches for pattern recognition [2].

1) Discriminant Analysis
2) Principal Component Analysis

1) Discriminant analysis: Discriminant Analysis is a supervised technique for dimensionality reduction and classification. Discriminant Analysis (DA) projects high dimensional data onto a low dimensional space so that maximum class separation can be achieved. Discriminant

Analysis tries to find linear combination of feature to separate two or more classes [1].

i) LDA: The standard LDA can be seriously degraded if there are only a limited number of observations N compared to the dimension of the feature space n. To prevent this from happen is it is recommended that the linear discriminant analysis be preceded by a principle component analysis. In PCA, the shape and location of the original data sets changes when transformed to a different space whereas LDA doesn't change the location but only tries to provide more class separability and draw a decision region between the given classes .

ii) FLDA: FLDA is the classical method for real-valued feature extraction using a linear transformation.FLDA is a supervised method and is designed optimally with its ability to maximize the ratio of between-class scatter and within-class scatter of projected features.

2) Principal component analysis: Principal component analysis is a statistical tool used to analyze data sets. The central idea of principal component analysis (PCA) is to reduce the dimensionality of a data set consisting of large number of interrelated variables, while retaining as much as possible of the variation present in the data set. The mathematics behind principle component analysis is statistics and is hinged behind standard deviation, eigenvalues and eigenvectors. The entire subject of statistics is based around the idea that you have this big set of data, and you want to analyze that set in terms of the relationships between the individual points in that data set [3].

III. NEURAL PATTERN TECHNIQUES

Neural Computing is technology which is based on the networks of "neuron like" units [4]. Neural networks can be viewed as massively parallel computing systems consisting of an extremely large number of simple processors with many interconnections. Neural network models attempt to use some organizational principles (such as learning, generalization, adaptivity, fault tolerance and distributed representation, and computation) in a network of weighted directed graphs in which the nodes are artificial neurons and directed edges (with weights) are connections between neuron outputs and neuron inputs. This weight adjustment of the network is known as Learning of the Neural Network [5]. The main characteristics of neural networks are that they have the ability to learn complex nonlinear input-output relationships, use sequential training procedures, and adapt themselves to the data.

The most commonly used family of neural networks for pattern classification tasks is the feed-forward network, which includes multilayer perceptron. These networks are organized into layers and have unidirectional connections between the layers. The first layer is called input layer and the last layer is called output layer. The layers, in between output and input layer are hidden layers. The performance of the network increases by increasing the number of hidden layer up to a certain level. These nodes serve the purpose of summation of all of its inputs. The output of a node is further applied to the next node. Two main neural networks discussed in this paper are:

1) Feed Forward Back Propagation Neural Network

2) General Regression Neural Network

1) Feed Forward Back-propagation Neural Network: In the backpropagation neural network model, the neurons are organized in the form of layers. The neurons in a layer get input from the previous layer and feed their output to the next layer. In this type of neural network, connections to the neurons in the same or previous layers are not permitted [6]. The architecture of FFBP-NN consists of input layer, hidden layer and output layer. In the forward procession, training data is applied on the Neural Network through the Input Layer. Then data is fed to the Hidden Layer, the Hidden Layer actually performs the processing. Finally the data is applied to Output Layer [2]. The evaluation of this Neural Network is made by applying unseen data on the network. If this network computes and predicts accurately then this network is properly trained, if not then different techniques are used for convergence.

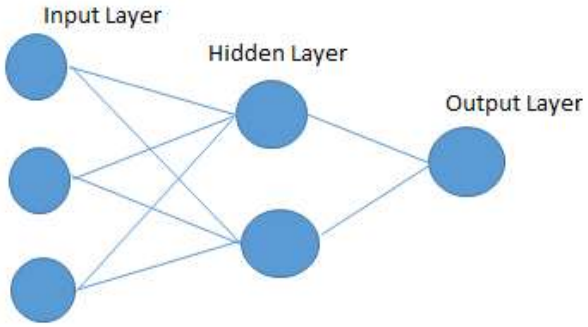

Fig1: Back Propagation Neural Network

2) General Regression Neural Network: The GRNN includes 4 different layers: input layer, hidden layer, summation layer and output layer [7]. The Input Layer transports the data attributes to the next layer in a parallel prototype. The second Hidden Layer consists of all the training samples. In the Summation Layer, the summation units or neurons perform a dot product on the attributes of the weight vector of the second layer. In the Output Layer, the local outputs are divided to get the predictions.

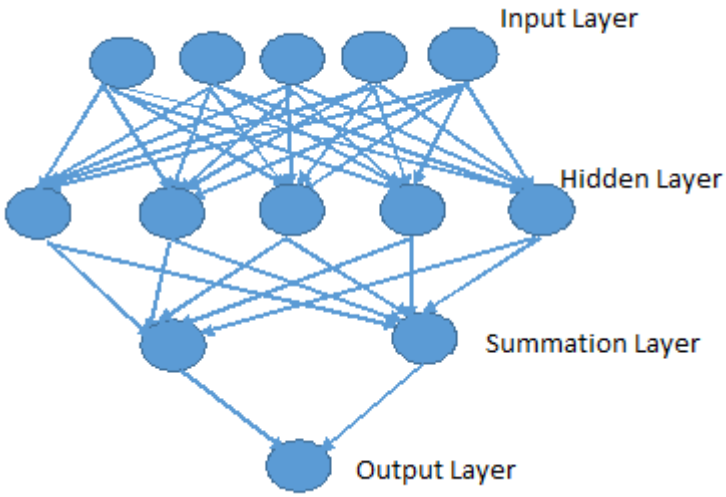

Fig 2: Block diagram for GRNN

CONCLUSION AND FUTURE WORK: In this paper pattern recognition techniques are categorized based on the supervised and unsupervised classification methods, in which the patterns are identified as a member of either a predefined class or an unknown class. Each of the technique have their own implementations and subtypes for feature extraction and processing. Comparison between statistical and neural network techniques with respect to various parameters will be carried out in the future work.

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