Chapter 14
Designing Extreme Learning Machine Network Structure Based on Tolerance Rough Set

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ABSTRACT

In this paper, we present a new extreme learning machine network structure on the basis of tolerance rough set. The purpose of this paper is to realize the high-efficiency and multi-dimensional ELM network structure. Various published algorithms have been applied to breast cancer datasets, but rough set is a fairly new intelligent technique that applies to predict breast cancer recurrence. We analyze Ljubljana Breast Cancer Dataset, firstly, obtain lower and upper approximations and calculate the accuracy and quality of the classification. The high values of the quality of classification and accuracy prove that the attributes selected can well approximate the classification. Rough sets approach is established to solve the prolem of tolerance.

INTRODUCTION

Intelligent transportation systems (ITSs) have had a wide impact on people's life in the past years. With the rapid development of computer vision and pattern recognition, more and more vision-based technologies are applied in TTSs for traffic control and management. Automatic license plate recognition (ALPR) plays an important role in ITSs for numerous applicators, such as road traffic monitoring, electronic payment systems and traffic law enforcement (COMINOS, 2012; Hassanien, 2004a).

Although the ALPR has a long research history, it is still a challenging task in complex traffic scenes because many factors affect the final recognition result, such as uneven lighting conditions, partial blurry license plate characters, etc. ALPR algorithms are generally composed of two major steps: license plate detection and character recognition. Initial treatment (surgery to remove the tumor and any lymph nodes to which the cancer may have spread) is usually complemented by chemotherapy, radiation therapy or hormonal therapy to reduce the risk of cancer recurring in the future (Chau, 2003; Panneer, 2016; Hamidi, 2016).

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The health care team will make every effort to remove all traces of a breast tumor during surgery. Many patients may never have a recurrence, but breast cancer may still recur in some patients. A recurrence can happen months or years after the original diagnosis and treatment. For example, even though a breast cancer tumor may appear small and localized, it may be aggressive and may have spread beyond the breast; this spread cannot always be detected by current methods (Hassanien, 2004b). This aggressiveness, as well as other factors, can lead to breast cancer recurrence. What's the worst is that a diagnosis of recurrent cancer is more devastating or psychologically difficult for a woman than her initial breast cancer diagnosis.

So, a physician must analyze data relating to the recurrence of breast cancer among patients according to medical factors. Generally, the purpose of all the related researches is identically to predict a cancer recurrence and at the same time, for the needs of improving the prediction accuracy in breast cancer recurrence. More and more researchers have tried to apply artificial intelligence related approaches for breast cancer prediction. The task here was to ascertain whether individuals suffered a recurrence of breast cancer based on nine medical variables.

In past decade, a class of single-hidden-layer feed forward neural networks (SLFNs) introduced by Huang and colleagues, called extreme learning machine (ELM), has drawn a great deal of attention from the machine learning community. Compared with the traditional gradient descent-based learning methods such as the error back propagation algorithm, the ELM gains the major advantage in the very fast training speed due to the fact that the network hidden layer weights and biases in ELM can be randomly assigned. After the input weights and the hidden nodes biases are chosen randomly, ELM is simply considered as a linear system and the output weights can be analytically determined by simple generalized inverse operation on the hidden layer output matrix. The ELM algorithm is founded on empirical risk minimization principle, which may thus suffer from the over fitting risk. According to the statistical learning theory, the expectation risk consists of the empirical risk and the structural risk. A learning model with good performance should elaborately balance both these risks. Thus, the regularized ELM (RELM) arose to make a tradeoff between them. In the implementation of ELM\RELM, it is found that good performance can be reached as long as the number of hidden nodes is large enough, say 1000. This symptom roots from the fact that ELM\RELM generated hidden nodes randomly, so it usually requires more hidden nodes than that of traditional neural networks to achieve matched performance. Larger network size than necessary results in longer running time in the testing phase of ELM\RELM, which may hamper its efficient application in some testing time sensitive scenarios. Hence, a lot of efforts were made to compact its architecture. Generally speaking, two possible strategies are pursued to tackle this issue. The first refers to constructive algorithms.

Recently, various published algorithms have been applied to build a computer-aided analysis system in medical field (Shi, 2005; Deb, 2009). The most commonly used algorithms are neural networks, Bayesian classifier (Zheng, 2005), genetic algorithms, decision trees, and fuzzy theory (Jin, 2013). Rough set theory (Vassiliadis, 2009) is a fairly new intelligent technique that has been applied to the medical domain and is used for the discovery of data dependencies, evaluates the importance of attributes, discovers the patterns of data, reduces all redundant objects and attributes, and seeks the minimum subset of attributes. Moreover, it is being used for the extraction of rules from databases. One advantage of the rough set is the creation of readable if-then rules. Such rules have a potential to reveal new patterns in the data material; furthermore, it also collectively functions as a classifier for unseen data sets. Unlike other soft computing methods, rough set analysis requires no external parameters and uses only the information presented in the given data. It is shown to be an interesting and powerful theory, and it has