DIVERSIFIED FIELDS AND CHARACTERISTICS OF ARTIFICIAL IMMUNE RECOGNITION SYSTEM (AIRS) - A COMPREHENSIVE SURVEY

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ABSTRACT

The Artificial Immune Recognition System (AIRS), is one of the supervised learning algorithm that has shown significant success on broad range of classification problems. The focus of this work is the AIRS algorithm, specifically the techniques history, previous research and algorithm function. Competence with the AIRS algorithm is demonstrated in terms of theory and application. The AIRS algorithm is analysed from the perspective of reasonable design goals for an immune inspired AIS and a number of limitations and areas for improvement are identified. The artificial Immune recognition system is one of the broad to the field of computational Intelligence.

Keywords: Artificial Immune Recognition System(AIRS), Data mining, Classification

1.INTRODUCTION

An artificial immune system (AIS) is a class of adaptive or learning computer algorithm inspired by function of the biological immune system, designed for and applied to difficult problems such as intrusion detection, data clustering, classification and search problems. It is critical at the outset to stress that although terminology and function of AIS are described using biological terms from the field of immunological research, they are taken as simplifications and abstractions and not intended to be models or representative of immunological response systems.

In recent years there has been considerable interest in exploring and exploiting the potential of Artificial Immune Systems for applications in computer science and engineering. These systems are inspired by various aspects of the immune systems of mammals. Some of these aspects, such as the distinction between self and non-self and the concept of negative selection, have a natural and intuitive for applications involving computer security, network intrusion detection, change detection, and the like. Moreover, research into natural immune systems suggests the existence of learning properties which may be used to advantage in machine learning systems. With the exception of, until very recently Artificial Immune System (AIS) research into machine learning has focused on the development of unsupervised learning and clustering rather than supervised learning and reinforcement learning.

.2. ALGORITHM CHARACTERISTICS

The AIRS algorithm was one of the first AIS technique designed specifically and applied to classification problems.

2.1 Self-regulation

A problem common to the field of artificial neural networks is the selection of an appropriate topology or neuronal architecture. AIRS does not require the user to select architecture, instead the adaptive process discovers or learns an appropriate architecture during training.

2.2 Performance

Empirical evaluation of the technique in [2] on standard classification problems from the University of California, Irvine [3], when compared to the empirical results of the best known classifiers from [4,5] show that AIRS is a competitive classification system. Results indicate that AIRS can achieve classification accuracy in the top five to top eight when ranked against some of the widely known best classification systems, and in the case of [6], is capable of achieving the best classification result known for some datasets.

2.3 Generalisation

Unlike techniques such as k-Nearest Neighbor that use the entire training dataset for classification, AIRS performs generalisation via data reduction. This means that the resulting classifier produced by the algorithm represents the training data with a reduced or minimum number of exemplars. It is typical for AIRS to produce classifiers with half the number of training instances.

2.4 Parameter Stability

The algorithm has a number of parameters that allows tuning of the technique to a specific problem, with the intent of achieving improved results. A feature of the algorithm is that over a wide range of parameter values, the technique is capable of achieving results within a few classification accuracy percentage points of the results achieved with an optimal parameter set.

3. THE ALGORITHM

The function of the AIRS algorithm is to prepare a pool of recognition or memory cells (data exemplars) which are representative of the training data the model is exposed to, and is suitable for classifying unseen data. The lifecycle of the AIRS system is as follows:

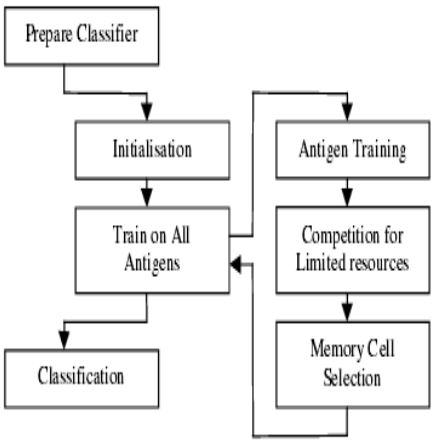


Fig.1:Life cycle overview of the AIRS algorithm

3.1 Initialisation

This step of the algorithm consists of preparing the data for use in the training process, and preparing system variables. The training data is normalized so that the range of each numeric attribute is in the range [0,1]. An affinity measure is required for use through the training process. The typical measure used is the inverted Euclidean distance. The important point here though is that the maximum distance measured between any two recognition cells or antigen and recognition cell (both simply data vectors) must also be in the range [0,1].

3.2 Antigen Training

The AIRS algorithm is a single-shot algorithm in that only one pass over the training data is required to prepare a classifier. Each antigen is exposed to the memory pool one at a time. The recognition cells in the memory pool are stimulated by the antigen and each cell is allocated a stimulation value (inverted affinity). The memory cell with the greatest stimulation is then selected as the best match memory cell for use in the affinity maturation process.

Competition for Limited Resources

After a number of mutated clones of the best matching memory cell are added to the ARB pool, the process of ARB generation and competition begins. This process can be described in the following figure

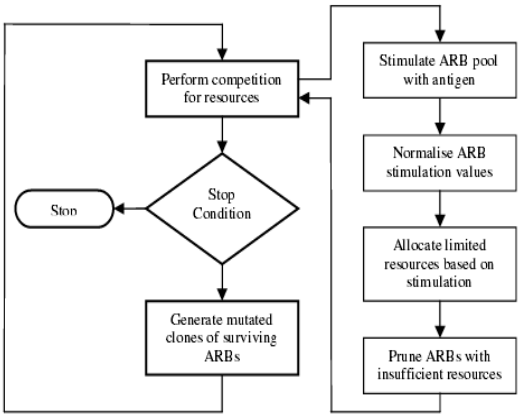


Fig.2: ARB cell refinement through competition for limited resources

The process is quite simple from a high-level. Competition for limited resources is used to control the size of the ARB pool and promote those ARBs with greater stimulation (and thus affinity) to the antigen being trained on. The stop condition in the middle of the loop allows the final step of clone generation to be avoided when the ARB pool reaches a desirable state. In this process only ARBs of the same class as the antigen are considered, meaning that the class of an ARB is never adjusted in the mutation process. The final step sees each ARB in the pool has mutated clones generated using the same clonal expansion and somatic hyper mutation steps used previous to generate mutated clones of the best match from the memory cell.

3.3 Memory Cell Selection

Once the stop condition for the ARB refinement process is completed, the ARB with the greatest normalized stimulation scoring is selected to become the memory cell candidate. The ARB is copied into

the memory cell pool if the stimulation value for the candidate is better than that of the original best matching memory cell. A check is made to determine if the original best matching memory cell should be removed. This occurs if the affinity between the candidate memory cell and the best matching cell is less than a cut-off.

3.4 Classification

When the training process is completed, the pool of memory recognition cells becomes the core of the AIRS classifier. The data vectors contained within the cells can be de-normalized or left as is for the classification process. Classification occurs using a k-Nearest Neighbor approach where the k best matches to a data instances are located and the class is determined via majority vote.

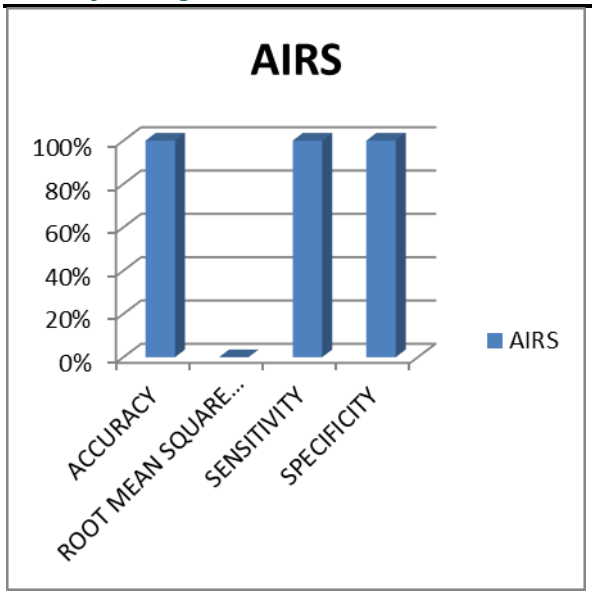
4. ARTIFICIAL IMMUNE SYSTEM WITH VARIOUS AREAS

4.1 APPLICATIONS OF ARTIFICIAL IMMUNE SYSETMS IN REMOTE SENSING IMAGE CLASSIFICATION

Liangpeiet. Al presented some initial investigations that are conducted to apply Artificial Immune system for classification of remotely sensing images. Remote sensing imagery classification task by Artificial immune system is attempted and the preliminary results are provided. The experiment was done in two steps: First, the classification task hires the property of clonal selection of immune system. The clonal selection recommends a description of the way the immune systems copes with the pathogens to mount an adaptive immune response. Second, classification results are assessed by three known algorithm: Parallelepiped Minimum Distance and Maximum Likelihood. It established that their method was efficient to the three traditional algorithms, and its overall accuracy and Kappa coefficient reach 89.80% and 0.8725 respectively.

4.2 RAIRS2: A New Expert System for Diagnosing Tuberculosis with Real-World Tournament Selection Mechanism inside Artificial Immune Recognition System

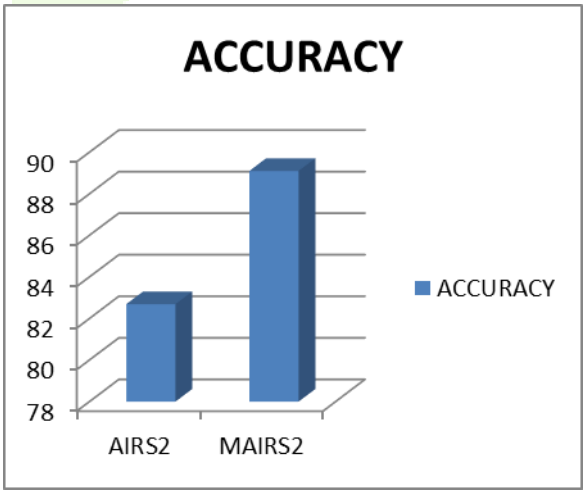
Mahmoud Reza Saybaniet. Al proposed a method for Tuberculosis using artificial immune recognition system. Tuberculosis is one of the dangerous health problems that has been ranked as the second leading cause of death byvirus. However, a small effort has been taken to increase its classification accuracy. In order to increase the classification accuracy, their study announced a new hybrid system that integrates real tournament selection mechanism into the AIRS. This mechanism is used to control the population size of the model and to overcome the existing selection pressure. Patient epacris reports attained from the Pasteur laboratory in northern Iran were used as the benchmark data set. The sample contained of 175 records, from which 114 (65 %) were positive for TB, and the remaining 61 (35 %) were negative.



The classification performance was measured through tenfold cross-validation, root-mean-square error, sensitivity, and specificity. With an accuracy of 100 %, RMSE of 0, sensitivity of 100 %, and specificity of 100 %, the proposed method was able to successfully classify tuberculosis cases.

4.3 Diagnosis of Diabetes Diseases Using an Artificial Immune Recognition System2 (AIRS2) with Fuzzy K-nearest Neighbor

Mohamed Amine Chikhet. Al used a modified AIRS2 called MAIRS2 where we replace the K- nearest neighbors algorithm with the fuzzy K-nearest neighbors to improve the diagnostic accuracy of diabetes diseases. The diabetes disease dataset used in our work is retrieved from UCI machine learning repository. The performances of the AIRS2 and MAIRS2 are evaluated regarding classification accuracy, sensitivity and specificity values. The highest classification accuracy obtained when applying the AIRS2 and MAIRS2 using 10-fold cross-validation was, respectively 82.69% and 89.10%.



4.4 Artificial Immune Recognition System-Based Classification Technique

KirtiBalaBahekaret. Al presented a paper for Artificial Immune Recognition System- Based various classification techniques in Data mining. These methods are being applied in the field of knowledge

generation, which helps in decision making and intersects many disciplines of computer science such as artificial intelligence, database, statistics, visualization, and high-performance parallel computing. An artificial immune system has a set of algorithm inspired by biological immune system. This algorithm supports machine learning, and they are designed to solve difficult problems such as intrusion detection and prevention, data clustering, classification, and exploration. The proposed method focuses on executing a supervised learning algorithm AIRS, i.e., artificial immune recognition system of AIS for classification. AIRS exhibits characteristics as self-regulation, performance empirical, and parameter stability.

5. CONCLUSION

In this paper the Artificial Immune Recognition Systemandits life cyclehas been analyzed. And also highlighted the various characteristics of artificial immune recognition system algorithm.The study focused the ArtificialImmune Recognition System (AIRS) and emphasized the different application areas of AIRS. Anumber of them embrace classification and bunch, optimization, learning, imageprocess, AI etc.

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