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A Conceptual Framework of Bacterial Foraging Optimization Algorithm for Data Classification

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Most previous works on Bacterial Foraging Optimization Algorithm (BFOA) for data classification were integrated BFOA as a feature selection algorithm and parameters optimizer for other classifiers. To the best of our knowledge, no effort has been carried out to fully utilize BFOA as a classifier. This paper presents a conceptual framework of instance-based BFOA. The proposed conceptual framework is designed based on the prototype searching approach whose target is to obtain an optimal reference set (cardinality) and simultaneously aim for high generalization performance by utilizing the strengths of BFOA.

Keywords: bacteria foraging optimization algorithm, data classification, k-nearest neighbor, prototype selection.

1. INTRODUCTION

Many efforts have been done to invent and design more advanced classification algorithms at both data and algorithmic levels. These classification algorithms can be divided into five major categories, which are neural network based, statistical based, rule based, instance selection and decision tree. This paper will focus on instance selection (IS) approach for later discussion.

Historically, many IS algorithms have been employed to improve the performance of nearest neighbor (NN). The problem with NN classifier is that it requires a large storage of instances and long response classification time due to large storage[1].

Therefore, the aim of IS algorithms is to reduce the training data as much as possible (or also known as sampling) and simultaneously attempt to achieve the highest possible classification accuracy using 1-nearest neighbor (1-NN) when dealing with the unseen data[2]. There are three different approaches of IS algorithms: noise filter, condensation and prototype searching[1]. Specifically this paper will focus on the prototype searching (PS) approach.

At present, there are more than 50 available PS algorithms[1,2]. Most of these PS algorithms are derived from nature-inspired algorithms such as genetic algorithm (GA)[3-5], evolutionary algorithm (EA)[2,6], ant colony optimization (ACO)[7-8], and particle swarm optimization (PSO)[9]. All these algorithms preserved its originality and applied stochastic heuristic search to locate the solution (a reference set) by transforming this searching problem into optimization problem.

In this paper, we are proposing instance-based Bacterial Foraging Optimization Algorithm (BFOA) for data classification using prototype searching approach. To the best of our knowledge, there have been no effort proposed to fully utilize BFOA as a PS algorithm. However, there were a number of efforts incorporating BFOA as a part of other classifiers which aims are to improve and increase the classification performance. For instance, BFOA has been employed for feature selection[10-15], and optimizing the parameters of other classifiers[16-23]. We found that with the assistance of BFOA, it is able to increase the generalization performance of other classifiers.

Interestingly, BFOA has been adopted and employed as a single clustering algorithm[24]. It shows outperformed result as compared to other clustering algorithms. This finding demonstrates that it is possible to adopt and adapt BFOA as a single classifier. With this motivation, this paper intends to modify original BFOA as a prototype

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