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# EVALUATING THE PERFORMANCE OF EVOLUTIONARY EXTREME LEARNING MACHINES BY A COMBINATION OF SENSITIVITY AND ACCURACY MEASURES

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**Abstract:** Accuracy alone can be deceptive when evaluating the performance of a classifier, especially if the problem involves a high number of classes. This paper proposes an approach used for dealing with multi-class problems, which tries to avoid this issue. The approach is based on the Extreme Learning Machine (ELM) classifier, which is trained by using a Differential Evolution (DE) algorithm. Two error measures (Accuracy,  $C$ , and Sensitivity,  $S$ ) are combined and applied as a fitness function for the algorithm. The proposed approach is able to obtain multi-class classifiers with a high classification rate level in the global dataset with an acceptable level of accuracy for each class. This methodology is evaluated over seven benchmark classification problems and one real problem, obtaining promising results.

Key words: *Accuracy, differential evolution, extreme learning machine, multiclass classification, multiobjective, neural networks, sensitivity*

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## 1. Introduction

In recent years, the imbalanced learning problem has drawn a significant amount of interest. The fundamental issue with the imbalanced learning problem is the ability of imbalanced data to significantly compromise the performance of most standard learning algorithms [1]. If the training methods are not proper, the features representing the classes that have a small number of examples in the training

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