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# On The Construction of Extreme Learning Machine for Online and Offline One-Class Classification - An Expanded Toolbox

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**Abstract:** One-Class Classification (OCC) has been prime concern for researchers and effectively employed in various disciplines. But, traditional methods based one-class classifiers are very time consuming due to its iterative process and various parameters tuning. In this paper, we present six OCC methods and their thirteen variants based on extreme learning machine (ELM) and Online Sequential ELM (OSELM). Our proposed classifiers mainly lie in two categories: reconstruction based and boundary based, where three proposed classifiers belong to reconstruction based and three belong to boundary based. We are presenting both types of learning viz., online and offline learning for OCC. Out of six methods, four are offline and remaining two are online methods. Out of four offline methods, two methods perform random feature mapping and two methods perform kernel feature mapping. We present a comprehensive discussion on these methods and their comparison to each other. Kernel feature mapping based approaches have been tested with RBF kernel and online version of one-class classifiers are tested with both types of nodes viz., additive and RBF. It is well known fact that threshold decision is a crucial factor in case of OCC, so, three different threshold deciding criteria have been employed so far and analyses the effectiveness of one threshold deciding criteria over another. Further, these methods are tested on two artificial datasets to check their boundary construction capability and on eight benchmark datasets from different discipline to evaluate the performance of the classifiers. Our proposed classifiers exhibit better performance compared to ten traditional one-class classifiers and ELM based two one-class classifiers. Through proposed one-class classifiers, we intend to expand the functionality of the most used toolbox for OCC i.e. DD toolbox. All of our methods are totally compatible with all the present features of the toolbox.

**Keywords:** One-class classification (OCC), Extreme Learning Machine (ELM), Online Sequential ELM (OSELM), One-Class ELM (OCELM), Autoassociative ELM (AAELM)

## 1. Introduction

Novelty or outlier detection [1] has been always prime attention of researchers in various disciplines and one-class classifier [2, 3] has been broadly applied for this purpose. One-class classification (OCC) was coined by Moya et al. [4]. It becomes necessity when data of only one class is available or the data belongs to other classes is very rare. For example, if we want to classify between healthy and unhealthy people. In this case, it is possible to define the range of the data for the healthy people but not possible to define such a definite range for unhealthy people. Because it is possible to prepare the data based on only existing diseases but not possible to prepare based on forthcoming diseases. Thus the data which is available for training can be taken as positive or normal samples and rest of the samples are not possible to define or very rare or unknown, can be taken as negative or abnormal. These abnormal samples are

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