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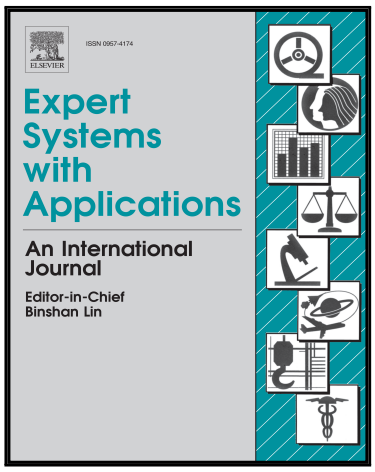

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ACCEPTED MANUSCRIPT

Learning from class-imbalanced data: Review of methods and applications

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Abstract: Rare events, especially those that could potentially negatively impact society, often require humans' decision-making responses. Detecting rare events can be viewed as a prediction task in data mining and machine learning communities. As these events are rarely observed in daily life, the prediction task suffers from a lack of balanced data. In this paper, we provide an in depth review of rare event detection from an imbalanced learning perspective. Five hundred and seventeen related papers that have been published in the past decade were collected for the study. The initial statistics suggested that rare events detection and imbalanced learning are concerned across a wide range of research areas from management science to engineering. We reviewed all collected papers from both a technical and a practical point of view. Modeling methods discussed include techniques such as data preprocessing, classification algorithms and model evaluation. For applications, we first provide a comprehensive taxonomy of the existing application domains of imbalanced learning, and then we detail the applications for each category. Finally, some suggestions from the reviewed papers are incorporated with our experiences and judgments to offer further research directions for the imbalanced learning and rare event detection fields.

Keywords: rare events, imbalanced data, machine learning, data mining

1. Introduction

Rare events, unusual patterns and abnormal behavior are difficult to detect, but often require responses from various management functions in a timely manner. By definition, rare events refer

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