Open-Set Recognition with Second-Order Extreme Value Theory

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The recent surge in the amount of available data has enabled the development of sophisticated machine learning models that excel at closed-set recognition tasks. However, in open-set recognition scenarios, where the model must distinguish between known and unknown classes, there is an increased risk of making incorrect decisions on novel data. Open-set recognition has thus become a crucial research area, especially in image recognition, where the identification of unknown objects presents significant challenges.

One promising approach for open-set recognition is the use of extreme value theory—a branch of mathematical statistics that studies the behaviour of extreme values of a distribution. In recent years, extreme value theory emerged as a powerful tool for machine learning, particularly for modelling rare events and outliers. Extreme value theory provides a natural framework for modelling the tails of a distribution, which are most relevant for detecting unseen classes. By incorporating extreme value theory into deep learning architectures, conventional models can be extended to handle challenging scenarios where unknown classes are present [1].

This presentation aims to address the problem of open-set image recognition by proposing a novel method based on the second-order limiting results of extreme value theory [2]. Our approach leverages a distance measure learned by a convolutional neural network with channel attention and the contrastive-centre loss, modified for open-set recognition. By incorporating second-order extreme value theory into our model, we can effectively capture the tail probabilities of the data distribution and improve the accuracy and robustness of open-set recognition. We demonstrate the effectiveness of our method on various image recognition benchmarks.

Keywords— open-set recognition, extreme value theory, image recognition

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