scientific reports



OPEN Hierarchical contrastive learning for multi-label text classification

Wei Zhang^{1,2}, Yun Jiang^{1,2}, Yun Fang¹ & Shuai Pan¹³³

Multi-label text classification presents a significant challenge within the field of text classification, particularly due to the hierarchical nature of labels, where labels are organized in a tree-like structure that captures parent-child and sibling relationships. This hierarchy reflects semantic dependencies among labels, with higher-level labels representing broader categories and lower-level labels capturing more specific distinctions. Traditional methods often fail to deeply understand and leverage this hierarchical structure, overlooking the subtle semantic differences and correlations that distinguish one label from another. To address this shortcoming, we introduce a novel method called Hierarchical Contrastive Learning for Multi-label Text Classification (HCL-MTC). Our approach leverages the contrastive knowledge embedded within label relationships by constructing a graph representation that explicitly models the hierarchical dependencies among labels. Specifically, we recast multi-label text classification as a multi-task learning problem, incorporating a hierarchical contrastive loss that is computed through a carefully designed sampling process. This unique loss function enables our model to effectively capture both the correlations and distinctions among labels, thereby enhancing the model's ability to learn the intricacies of the label hierarchy. Experimental results on widelyused datasets, such as RCV1-v2 and WoS, demonstrate that our proposed HCL-MTC model achieves substantial performance gains compared to baseline methods.

Keywords Contrastive learning, Hierarchical structure, Multi-task, Multi-label text classification

The task of text classification, a cornerstone of natural language processing (NLP), has recently attracted increased interest. Its applications span a wide range of fields, including sentiment analysis^{1,1}, document categorization¹, medical codes prediction¹, legal studies¹, patent classification¹, and financial analysis^{1,1}. Among these, Multi-label Text Classification (MTC) stands out as a particularly complex challenge. In MTC, the goal is to assign multiple labels to a given text, where the set of labels often exhibits a hierarchical structure. This structure implies a relationship between labels, such that information pertaining to one label can influence the inference of another, thereby adding complexity to the classification task.

The current approaches to the MTC task can be broadly classified into two categories: (1) methods that predict labels using textual information alone, and (2) approaches that combine both label and textual information for prediction. The first category of methods relies on local and global features extracted by text encoders to forecast labels. Notable examples include CNN-based models^{3,28} that address data imbalance issues caused by a lack of samples for child labels. Other works in this category focus on incorporating semantic information from text¹¹. While these methods are effective at capturing textual subtleties, they generally full to account for relationships between labels.

The second category of methods aims to integrate textual and label information. Strategies include weight initialization [3], learning label hierarchies [3-1], and the use of capsule networks [6-1]. These approaches improve the efficiency of MTC by leveraging label information but often achieve only a superficial understanding of the label hierarchy. The graph convolutional network (GCN)-based model [6] shows promise in learning a deep label hierarchy but does not fully exploit label information, focusing exclusively on correlative aspects and overlooking label distinctiveness.

Despite substantial progress, a critical gap in research persists: the majority of current methods do not effectively utilize both the distinctive and correlative aspects of label information to optimize hierarchical multi-label classification. This shortcoming restricts the effectiveness of these models, especially in complex, hierarchical label structures where both types of information are essential for accurate classification.

The concurrent consideration of correlative and distinctive information is fundamental to achieving a deep understanding of the label hierarchy, thus improving the effectiveness of MTC. As depicted in Fig. 1, the similarity #21 between nodes 2 and 3 represents distinctive information, which is presumed to be maximized

Advanced Institution of Information Technology, Peking University, No.233, Yonghui Rd, Hangzhou 311215, Zhejiang, China. Wei Zhang and Yun Jiang contributed equally to this work. Email: pens@aiit.org.cn

Active Learning For Hierarchical Text Classi Cation

Sabine Zange

Active Learning For Hierarchical Text Classi Cation:

This book delves into Active Learning For Hierarchical Text Classi Cation. Active Learning For Hierarchical Text Classi Cation is a vital topic that must be grasped by everyone, from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Active Learning For Hierarchical Text Classi Cation, encompassing both the fundamentals and more intricate discussions.

- 1. The book is structured into several chapters, namely:
 - Chapter 1: Introduction to Active Learning For Hierarchical Text Classi Cation
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- 2. In chapter 1, the author will provide an overview of Active Learning For Hierarchical Text Classi Cation. This chapter will explore what Active Learning For Hierarchical Text Classi Cation is, why Active Learning For Hierarchical Text Classi Cation is vital, and how to effectively learn about Active Learning For Hierarchical Text Classi Cation.
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- 4. In chapter 3, the author will examine the practical applications of Active Learning For Hierarchical Text Classi Cation in daily life. The third chapter will showcase real-world examples of how Active Learning For Hierarchical Text Classi Cation can be effectively utilized in everyday scenarios.
- 5. In chapter 4, the author will scrutinize the relevance of Active Learning For Hierarchical Text Classi Cation in specific contexts. The fourth chapter will explore how Active Learning For Hierarchical Text Classi Cation is applied in specialized fields, such as education, business, and technology.
- 6. In chapter 5, the author will draw a conclusion about Active Learning For Hierarchical Text Classi Cation. The final chapter will summarize the key points that have been discussed throughout the book.

 This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. It is highly recommended for anyone seeking to gain a comprehensive understanding of Active Learning For Hierarchical Text Classi Cation.

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