



OPEN Hierarchical contrastive learning for multi-label text classification

Wei Zhang^{1,2}, Yun Jiang^{1,2}, Yun Fang³ & Shuai Pan^{1,2}✉

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 widely-used 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^{1–4}, document categorization⁵, medical codes prediction⁶, legal studies⁷, patent classification⁸, and financial analysis⁹. 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^{10–12} 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 fail to account for relationships between labels.

The second category of methods aims to integrate textual and label information. Strategies include weight initialization¹³, learning label hierarchies^{14–16}, and the use of capsule networks^{16,17}. 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 model¹⁸ 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 s_{23} between nodes 2 and 3 represents distinctive information, which is presumed to be maximized

¹Advanced Institution of Information Technology, Peking University, No.233, Yonghui Rd, Hangzhou 311215, Zhejiang, China. ²Wei Zhang and Yun Jiang contributed equally to this work. [✉]email: pans@aiit.org.cn

Active Learning For Hierarchical Text Classification

Thomas Griffiths



Active Learning For Hierarchical Text Classification:

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Table of Contents Active Learning For Hierarchical Text Classification

1. Understanding the eBook Active Learning For Hierarchical Text Classification
 - The Rise of Digital Reading Active Learning For Hierarchical Text Classification
 - Advantages of eBooks Over Traditional Books
2. Identifying Active Learning For Hierarchical Text Classification
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Active Learning For Hierarchical Text Classification
 - User-Friendly Interface
4. Exploring eBook Recommendations from Active Learning For Hierarchical Text Classification
 - Personalized Recommendations
 - Active Learning For Hierarchical Text Classification User Reviews and Ratings

- Active Learning For Hierarchical Text Classification and Bestseller Lists
- 5. Accessing Active Learning For Hierarchical Text Classification Free and Paid eBooks
 - Active Learning For Hierarchical Text Classification Public Domain eBooks
 - Active Learning For Hierarchical Text Classification eBook Subscription Services
 - Active Learning For Hierarchical Text Classification Budget-Friendly Options
- 6. Navigating Active Learning For Hierarchical Text Classification eBook Formats
 - ePub, PDF, MOBI, and More
 - Active Learning For Hierarchical Text Classification Compatibility with Devices
 - Active Learning For Hierarchical Text Classification Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Active Learning For Hierarchical Text Classification
 - Highlighting and Note-Taking Active Learning For Hierarchical Text Classification
 - Interactive Elements Active Learning For Hierarchical Text Classification
- 8. Staying Engaged with Active Learning For Hierarchical Text Classification
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Active Learning For Hierarchical Text Classification
- 9. Balancing eBooks and Physical Books Active Learning For Hierarchical Text Classification
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Active Learning For Hierarchical Text Classification
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Active Learning For Hierarchical Text Classification
 - Setting Reading Goals Active Learning For Hierarchical Text Classification
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Active Learning For Hierarchical Text Classification
 - Fact-Checking eBook Content of Active Learning For Hierarchical Text Classification
 - Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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