E-CARP: An Interpretable Text Classification Framework Based on Enhanced Context-Aware Reasoning Postprint

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Abstract

This paper proposes an Enhanced Context-Aware Reasoning Framework (E-CARP) to improve the performance and interpretability of text classification tasks. This framework employs a fully endogenous parametric memory network to store domain knowledge and combines it with a dynamic relational reasoning mechanism to achieve efficient semantic understanding. Specifically, this method innovatively utilizes the multi-head attention mechanism of pre-trained language models to dynamically activate semantic features of keywords, avoiding dependence on external knowledge bases; designs a lightweight template matching rule base to support real-time recognition of complex semantic relationships such as antonymy and intensification; and achieves efficient implicit knowledge retrieval through trainable memory matrices and cosine similarity computation. Experiments on product review sentiment classification tasks demonstrate that E-CARP maintains 89.7% classification accuracy while reducing inference latency to 138 ms, achieving 3.2× efficiency improvement over traditional external knowledge base-based methods. Ablation studies further validate the memory network's capability to capture long-tail domain knowledge, resulting in a 19.6% improvement in classification performance under low-resource scenarios. Furthermore, the framework enhances model decision interpretability through attention weight visualization and relational reasoning chain generation, providing a viable solution for text classification applications requiring high trustworthiness, such as healthcare and law. This study provides a new technical pathway for lightweight knowledge-enhanced NLP systems, possessing significant theoretical value and practical implications.

Full Text

E-CARP: An Enhanced Context-Aware Reasoning Framework for Interpretable Text Classification

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Abstract

This paper proposes an Enhanced Context-Aware Reasoning Framework (E-CARP) to improve both performance and interpretability in text classification tasks. The framework employs a fully endogenous parametric memory network to store domain knowledge and integrates a dynamic relation reasoning mechanism for efficient semantic understanding. Specifically, our approach innovatively leverages the multi-head attention mechanism of pretrained language models to dynamically activate semantic features of keywords, eliminating dependency on external knowledge bases; designs a lightweight template matching rule library to support real-time recognition of complex semantic relationships such as antonymy and intensification; and implements efficient implicit knowledge retrieval through a trainable memory matrix combined with cosine similarity computation.

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Keywords: Text classification, context-aware reasoning, memory networks, dynamic relation reasoning

Note: Figure translations are in progress. See original paper for figures.