

Advancements in AI for Reasoning with Complex Data

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Artificial intelligence has made remarkable progress in reasoning over complex, structured, multimodal, and multilingual data, addressing critical challenges in domains such as finance and healthcare. This abstract underscores key advancements in tabular reasoning, temporal analysis, and structured multimodal reasoning.

Key contributions include the development of TempTabQA (Gupta et al. 2023), a benchmark for temporal question answering, along with novel methods for enhancing temporal reasoning in large language models (LLMs). Additionally, a framework for evaluating mathematical reasoning in financial documents (Srivastava et al. 2024) has been introduced, establishing robust techniques for interpreting time-sensitive and quantitative data. Building on these foundations, we have developed hybrid SQL-text adaptive reasoning models (H-STAR) and knowledge-aware reasoning techniques for semi-structured tables (Mathur et al. 2024), enabling precise and efficient handling of complex queries.

In the vision-language domain, our contributions include advancements in spatial reasoning for geographic data (MAPWise) (Mukhopadhyay et al. 2024b), methods to improve robustness in chart interpretation (FlowVQA) (Singh et al. 2024), and evaluations of LLMs' ability to understand visual data, such as charts (RobustCQA) (Mukhopadhyay et al. 2024a). Furthermore, we have addressed challenges in multilingual and cross-modal robustness through innovations such as multilingual table synchronization (InfoSync) (Khincha et al. 2023), concurrent robustness evaluations across languages and modalities (Gupta et al. 2024), and numerical reasoning in tabular data (Akhtar et al. 2023).

Our work aims to enhance reasoning on dynamically evolving data using hybrid LLM-SQL queries, symbolic query generation, and multi-table retrieval techniques. We also plan to tackle challenges in interpreting hierarchical table structures, analyzing multiple complex chart types, and exploring diverse map types, while advancing real-world multimodal data analysis. Additionally, we plan to improve table generation in both closed/open-book scenarios and refine evaluation frameworks for structured tasks.

These advancements demonstrate the potential of AI in tackling complex, multimodal data and delivering impactful real-world solutions.

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