

A master’s Thesis University of Applied Science and Art, Lucerne Data Science Department

NL2GeoSQL - Agentic information retrieval from Geospatio-Temporal information systems



Problem Formulation

Interacting with relational databases necessitates the capability to efficiently execute queries, which frequently requires specialized knowledge of SQL. The process of text-to-SQL parsing for Large Language Models (LLMs) seeks to bridge this gap, making database access more user-friendly for non-experts by converting natural language queries into SQL commands. This goal has prompted the creation of innovative methods, primarily centered on prompt engineering and fine-tuning. This survey offers a thorough overview of LLMs in Text-to-SQL tasks, encompassing the generation of custom datasets, advancements in prompt engineering, fine-tuning techniques, and potential future research directions.

Problem Action

The following steps are planned. First, a spatial database will be created locally using IBM-provided data. Next, candidate models will be identified(IBM Granite8B, Meta LLaMA3.1).To optimize the models’ performance, a spatial dataset will first be generated, followed by QLoRA fine-tuning to enhance their capabilities. Additionally, in-context learning techniques will be employed to further improve their performance. A LangChain-based pipeline will then be developed to enable seamless interaction with the spatial database, providing a robust framework for evaluation. Finally, the system will be tested on spatial queries to assess its accuracy, efficiency, and overall effectiveness.

Result

The evaluation demonstrated that the highest average accuracy was achieved with Granite hosted in RITS, guided by an optimized meta-prompt. This highlights that prompt engineering can be a highly promising

approach for guiding the model in Text-to-SQL tasks, especially when the prompt is well-structured and incorporates few-shot examples. Furthermore, embedding a chain-of-thought process within the prompt can effectively guide the model in navigating from the input question to the correct path in the database.

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