

AI4Steel – A Multi-Agent Framework for Human-in-the-Loop Database Querying

Enhancing Production and Logistic Efficiency in the Steel Industry Through Human-AI Collaboration



Pro²Future



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MOTIVATION & GOALS

This project supports **voestalpine domain experts** in accessing databases **without SQL proficiency**. Voestalpine's **legacy system** was outdated and produced unreadable SQL. While current **LLM-based Text-To-SQL** approaches perform well on benchmarks, they **fail industrially** because domain knowledge lives in experts' heads, not in schema metadata, producing **unverifiable black-box SQL**. Our system keeps experts in **full control of query correctness** through:

- Replace the **legacy system** with a **web-based, human-in-the-loop** tool for querying without SQL
- Ensure **full explainability** through **visible, reviewable and reversible AI changes**
- Deliver **readable, verifiable queries** through a **visual-tree-based editor**

Project FactBox

Project Name AI4Steel
Project ID MFP II A.1-2
Duration 48 Months

Area 3
Area Analytics

Project Lead
DI Dr. Belgin Mutlu

APPROACH

- Our approach pairs a visual **Tree-based Query builder** with an **AI assistant** in a web-based application, utilizing a **multi-agent architecture** backed by a **Graph-RAG system** to navigate complex industrial schemas.
- To ensure complete transparency, the assistant provides **intuitive graph-based visualizations** of discovered database relationships, while employing a **human-in-the-loop design** where proposed changes is reviewed and approved.
- The system translates validated structure into final **SQL query**.

CONTRIBUTION

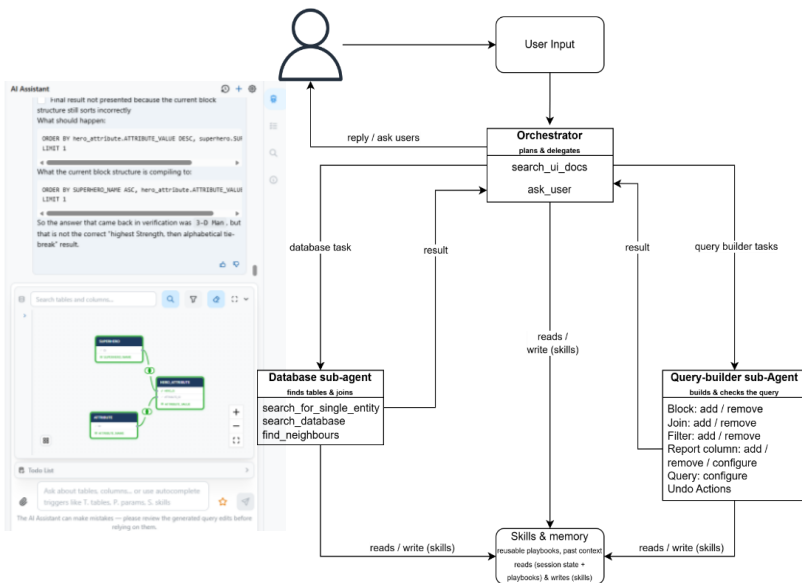
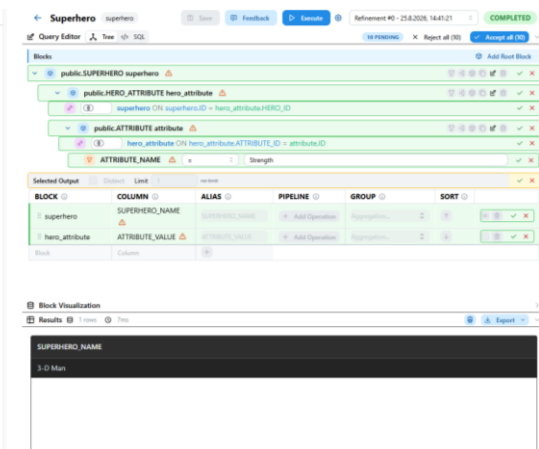
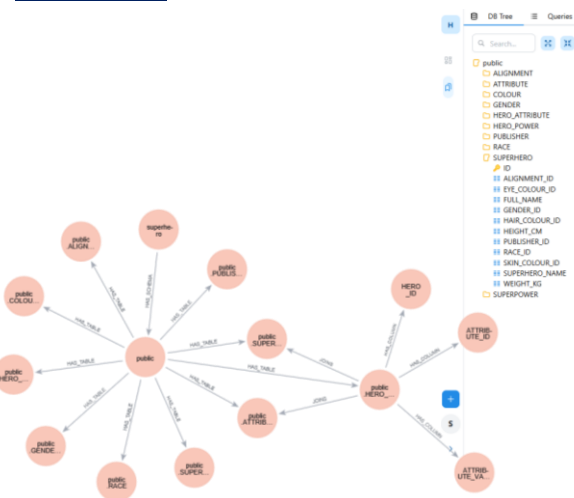
Scientific contribution

- Human-in-the-loop framework for trustworthy AI-assisted database querying
- Explainable visual query building with transparent & reversible AI actions
- Multi-agent AI architecture for query generation, validation, and explanation
- Advances research on explainable and trustworthy industrial AI systems

Economic contribution

- Faster data access without SQL expertise
- Improved productivity through AI-assisted query creation
- Readable, verifiable, and auditable query generation
- Multi-agent assistance improves query quality and user confidence
- Foundation for scalable, data-driven decision-making across voestalpine

PROTOTYPE



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voestalpine

ONE STEP AHEAD.

