IntelliSQL: Intelligent SQL Querying with LLMs using Gemini Pro

Abstract

IntelliSQL stands as a cutting-edge Generative AI-powered solution, meticulously crafted to revolutionize and simplify interactions with SQL databases. This innovative application empowers users by enabling them to articulate their data needs through natural language questions. These intuitive linguistic inputs are then seamlessly and accurately converted into precise SQL queries, leveraging the advanced capabilities of Google's Gemini 1.5 models. By bridging the gap between human language and structured query language, IntelliSQL significantly streamlines the entire querying process. This not only enhances the overall user experience but also democratizes data access, making it profoundly intuitive and accessible for a diverse range of users, from seasoned technical professionals to individuals with no prior SQL knowledge. Through its intelligent design, IntelliSQL aims to foster more efficient data retrieval, analysis, and decision-making by removing the common technical barriers associated with traditional database management.

Objective

- Enable natural language interaction with SQL databases.
- Provide intelligent assistance for query formulation.
- Offer instant execution and results display from the database.

Key Features

- Natural Language to SQL Conversion
- Real-Time Query Execution with SQLite
- LLM-Powered Suggestions using Gemini API
- Interactive UI with Streamlit
- Modular and Maintainable Code

Technologies Used

Component	Technology
UI Framework	Streamlit
LLM Integration	Google Gemini 1.5 Pro / Flash
Language	Python
Database	SQLite
API Security	Python-dotenv for environment keys

Architecture Diagram

Natural Language Query

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LLM (Gemini via API)

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SQL Query Generated

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Query Execution on SQLite

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Response Displayed via Streamlit

Modules Overview

a. app.py

- Controls page routing and rendering.
- Streamlit layout for navigation: Home, About, Query Assistant.
- Renders user input field and displays results.

b. sql.py

- Reads and executes SQL queries from the generated string.
- Handles SQLite connection.

c. trial.py

- Gemini integration test.
- Used to verify prompt results and API responses.

Prompt Configuration

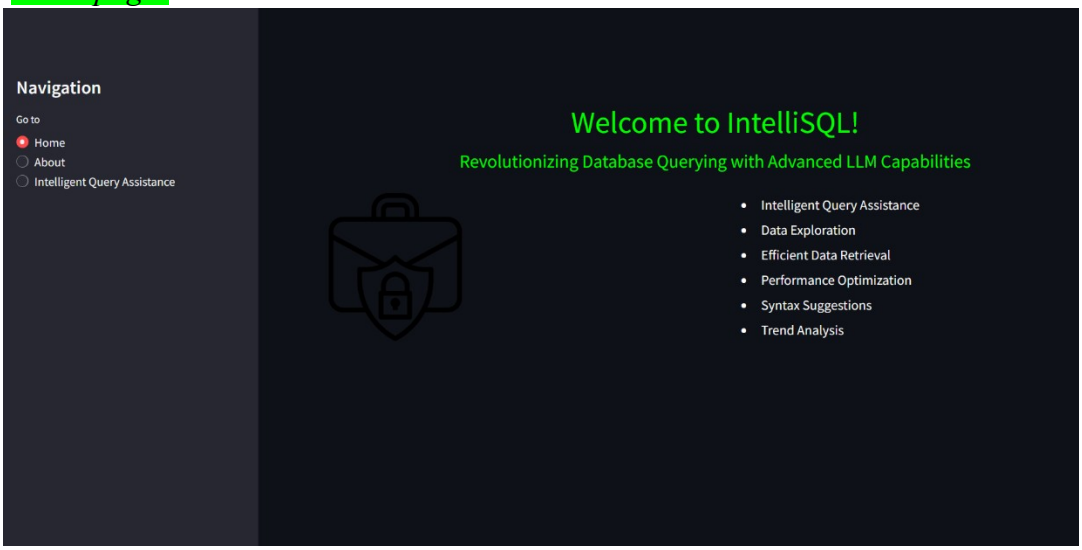
```
prompt = [

    "You are an expert at converting English questions into SQL queries. \

    The SQL database is named STUDENTS and has the following columns: \

    NAME, CLASS, Marks, Company."

    "Example 1: How many entries of records are present?
      SQL: SELECT COUNT(*) FROM STUDENTS;"

    "Example 2: Tell me all the students studying in MCom class?
      SQL: SELECT * FROM STUDENTS WHERE CLASS='MCom';"

]
```

User Flow

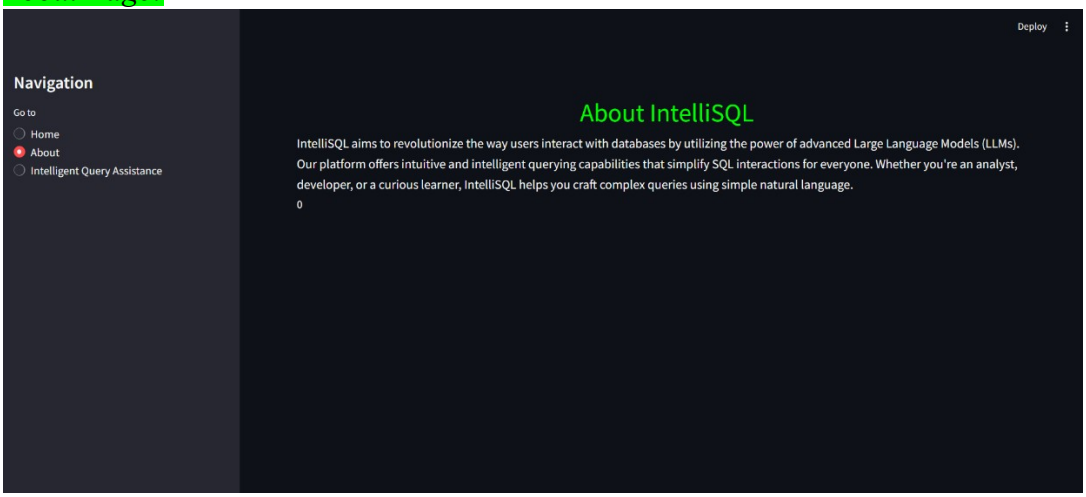
1. User accesses the IntelliSQL interface.
2. Inputs natural language query.
3. LLM converts query into SQL.
4. SQL is executed on local database.
5. Results are shown in a table format.

Screenshots

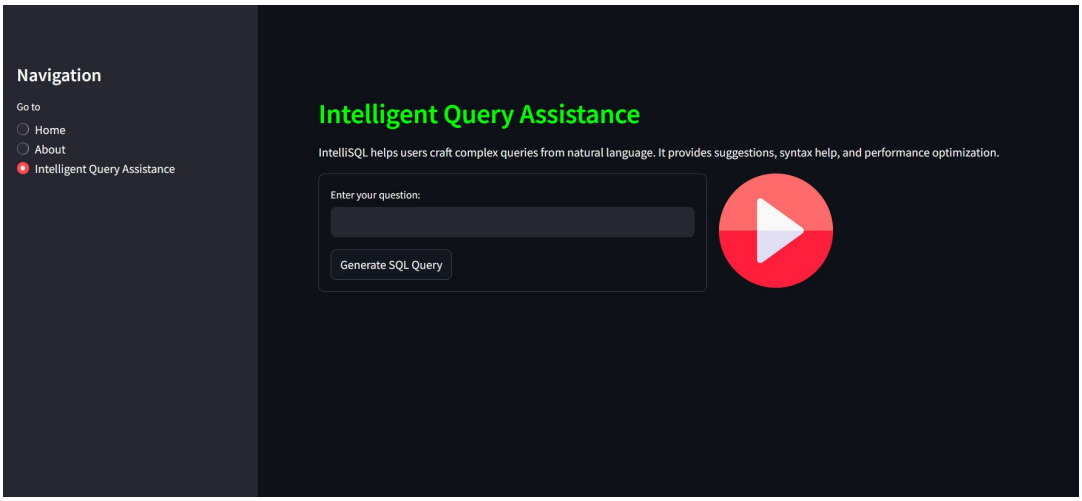
Home page:



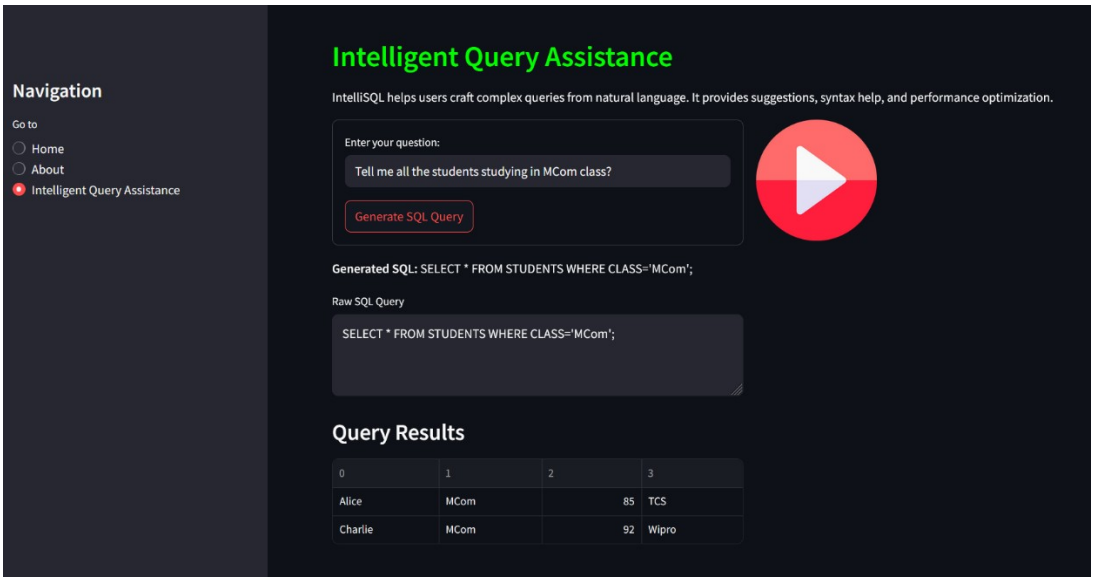
About Page:



Query Assistance page:



Generated Query & Result:



Installation & Setup Instructions

1. Clone the Repository

git clone https://github.com/yourusername/intellisql.git

cd intellisql

2. Create a .env file

GOOGLE_API_KEY="your-api-key-here"

3. Install dependencies

pip install -r requirements.txt

4. Run the application

streamlit run app.py

Conclusion

In conclusion, IntelliSQL stands as a pivotal advancement in database interaction, effectively bridging the inherent gap between intuitive natural language and the precise, structured syntax of SQL. By leveraging cutting-edge Large Language Models (LLMs) like Google's Gemini 1.5, this solution dramatically enhances accessibility and usability for all database users. It successfully reduces technical barriers, empowering both technical and non-technical individuals to seamlessly retrieve and analyze data. Ultimately, IntelliSQL not only simplifies the querying process but also actively promotes a more efficient and inclusive environment for data-driven decision-making, fostering deeper insights and improved operational agility within any organization.

Future Scope

- Integration with multiple database types (e.g., MySQL, PostgreSQL).
- Multi-query support.
- Admin panel with analytics on query usage.

Credits

Developer: Daivansh Pushkarna
Platform: Google Gemini API + Streamlit

Important Links

- Gemini API Documentation
- Streamlit Documentation