

System Overview

- **Retail Insights Assistant — Local LLM Architecture**
- Powered by a local Mistral model using Ollama
- Supports two modes:
 - **Dataset Summarization Mode**
 - **Conversational SQL Q&A Mode**
- Ingests and cleans large, inconsistent retail CSV files
- Loads all cleaned data into **DuckDB**
- Uses multi-agent architecture for SQL generation, validation, and execution
- Ensures fast and reliable data analytics

Data Pipeline Architecture

- **CSV Ingestion & Cleaning**
- Multi-strategy CSV reading for inconsistent datasets
- Filename and column name normalization
- Cleaning rules applied to:
 - **Status** (mapped to shipped/cancelled/returned)
 - **Amount** (converted to numeric)
 - **Quantity** (converted to integer)
 - **Dates** (standardized formats)
- Cleaned CSVs are saved and ready for processing
- **DuckDB Integration**
- Each cleaned CSV becomes a DuckDB table
- Two unified structures created:
 - **Each csv table**
 - **master_sales table** (merging compatible sales tables)
- Ensures consistent analytics across multiple files

Summarization Mode

- **Purpose:**
Provide a deep, narrative-style understanding of the dataset.
- **Summarization Workflow**
- User selects a table
- System retrieves data from DuckDB
- Python computes insights:
 - Total rows
 - Data types
 - High-variance numeric columns
 - High-uniqueness categorical columns
 - Statistical summaries
- This metadata is fed into the Mistral LLM
- The LLM generates:
 - Column-level insights
 - Patterns and trends
 - Anomalies
 - Business interpretations
 - Data quality issues
- **Output:**
A structured, human-readable dataset summary.

Conversational Q&A Mode

- **Goal:**
Convert natural language questions into SQL and return results.
- **Pipeline**
- **1. LanguageToSQLAgent**
- Converts user questions to SQL using Mistral
- Uses real table schema
- Generates safe, schema-correct DuckDB SQL
- **2. ValidationAgent**
- Blocks unsafe queries
- Only allows **SELECT** queries
- Prevents DROP/DELETE/UPDATE/ALTER/INSERT/CREATE
- **3. SQLExecutionAgent**
- Executes validated SQL in DuckDB
- Returns clean, formatted data back to the UI
- **Capabilities:**
- Fuzzy logic for messy retail data
- Filters and aggregations
- Instant tabular and json results