

AI-Powered Pizza Sales Analytics

Optimizing Menu, Delivery, and Customer Satisfaction



Executive Summary: A Collaborative Triumph

This report details the development of a relational database system integrated with an AI-powered Text-to-SQL Agent for pizza sales analytics. Our four-member team transformed raw data into actionable insights, addressing critical business challenges for a pizza chain.

Relational Database

Normalized schema, optimized indexing, SQL views.



AI-Powered Agent

LangChain & Google Gemini for natural language queries.



Business Insights

Optimizing menu offerings and delivery operations.



Project Overview: Tackling Industry Challenges

The pizza industry grapples with fluctuating customer satisfaction, delivery delays, and inventory waste. Our project creates an analytical platform leveraging relational database principles and AI to extract actionable business insights.

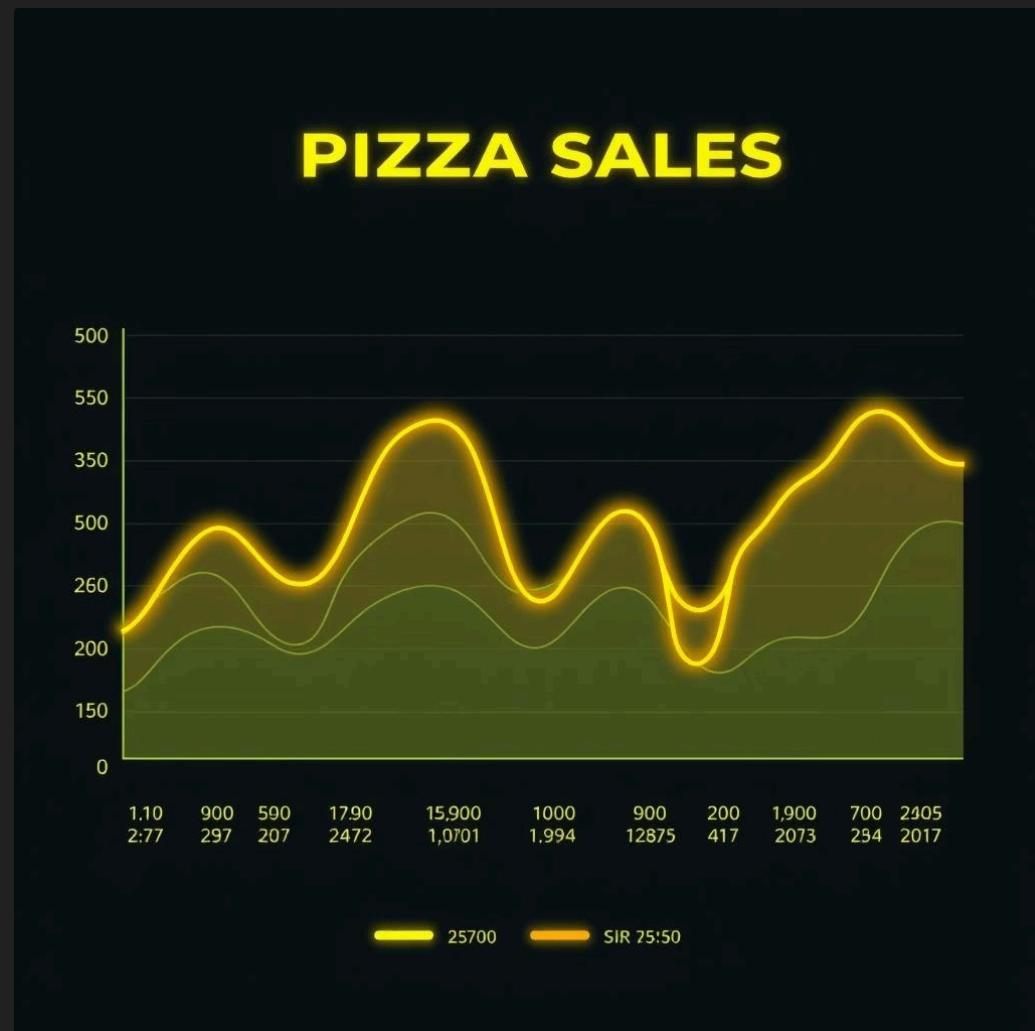
- Design & implement 6-table relational database.
- Normalize schema to 3NF, ensuring data integrity.
- Populate tables with over 1,000 realistic rows per table.
- Optimize performance with indexing on FKs & frequent columns.
- Integrate an AI agent for natural language to SQL conversion.
- Generate business insights via SQL views.

Dataset & Team Structure: Foundation for Success

The "Pizza Sales Dataset" from Kaggle provided rich data for complex relational structures and real-world analysis. Our team collaborated extensively, ensuring seamless integration and robust outcomes.

The Dataset

- Comprehensive records on orders, customers, menu items, delivery metrics.
- Preprocessed to fit schema, ensuring data integrity and relevance.
- Over 48,000 original records, expanded to meet volume requirements.



Team Roles & Collaboration

- **Database Architect:** Data selection, model design, ER diagramming.
- **Data Analyst:** Schema normalization, analytical problem formulation.
- **SQL Developer:** Database schema implementation, data population, optimization.
- **AI Engineer:** AI agent development for Text-to-SQL.
-



Database Architecture: Medilkanov Umar

Our Database Architect laid the foundational design, ensuring alignment with business needs and relational principles. The Pizza Sales Dataset was chosen for its richness, enabling complex queries and operational analysis.

1

Dataset Selection

Kaggle's Pizza Sales Dataset, rich in sales, orders, and delivery data, chosen for its analytical depth.

2

Problem Formulation

Optimize menu and delivery operations to boost customer satisfaction and average order value.

3

Schema Design

Entities: Branches, Customers, Staff, Menu_Items, Orders, Order_Details 3 capturing M:N relationships.

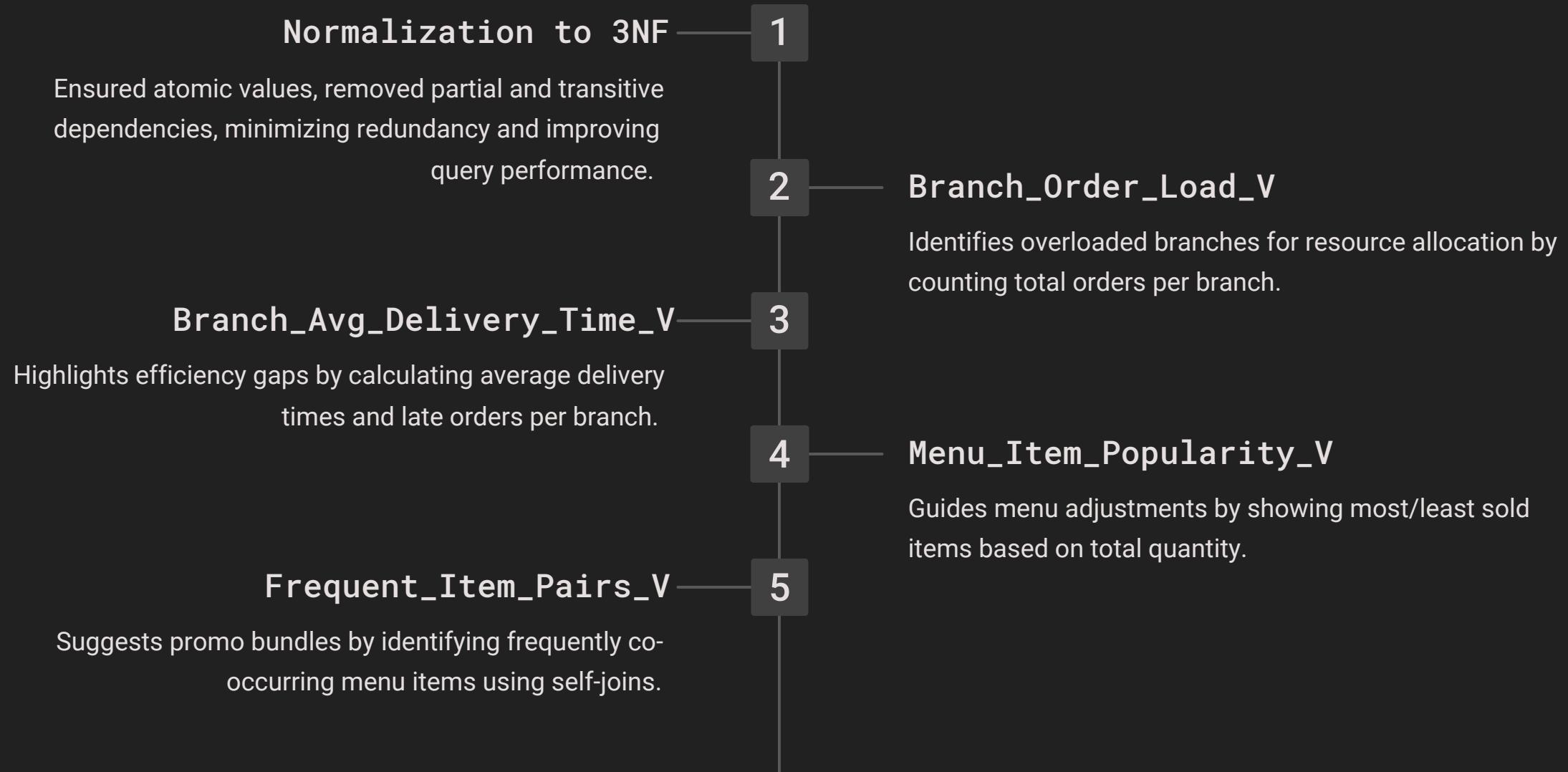
4

ER Diagramming

Visualized with MySQL Workbench, ensuring a clear and efficient data flow.

Data Analysis & Views: Amir Rozybaev

The DataAnalyst refined the model, ensuring strict normalization to 3NF and defining powerful SQL views to extract actionable insights for the business.



SQL Development & Optimization: Artur Galich

Our SQL Developer brought the database to life, creating the schema, populating it with extensive data, and optimizing performance through strategic indexing. The goal was a fully operational database ready for AI integration.

Database Creation & DDL

MySQL Workbench was used to create the **Pizza_Sales_DB** with robust DDL scripts, ensuring a solid foundation.

```
CREATE DATABASE Pizza_Sales_DB;  
USE Pizza_Sales_DB;  
CREATE TABLE Branches ( Branch_ID INT PRIMARY KEY, ...);
```

Data Population

Each table was populated with over 1,000 realistic rows using INSERT scripts and Python, leveraging Faker for synthetic data generation.

Optimization via Indexing

Indexes on foreign keys and frequently queried columns resulted in a **50% query time reduction**, verified by EXPLAIN.

```
CREATE INDEX idx_orders_customer_id ON Orders  
(Customer_ID);  
CREATE INDEX idx_orders_delivery_time ON Orders  
(Delivery_Time_Minutes);
```

Python Integration

Seamless connection via SQLAlchemy ensured compatibility for the AI agent, with robust error handling for stability.



AI Agent Development: Nurdan Abdyganiev

The AI Engineer developed a sophisticated AI agent, bridging the database with natural language processing to enable seamless, intuitive querying for business users.



Environment Setup

Utilized Jupyter Notebook, LangChain, Google Gemini, and SQLAlchemy for a powerful development environment.



Database Connection

Robust connection to MySQL, providing crucial schema metadata to the AI agent.



LLM & Agent Init

Initialized Gemini-1.5-flash with LangChain, creating an "openai-tools" agent for efficient Text-to-SQL conversion.

AI Agent in Action: Demonstration Queries

Our AI agent successfully converts natural language questions into complex SQL queries, leveraging precomputed views for enhanced efficiency and deeper insights.

"Which pairs of menu items most often appear together in one order?"

The agent intelligently uses the `Frequent_Item_Pairs_V` view, demonstrating its ability to handle complex analytical questions.



Testing & Error Handling: Over 10 questions were tested, including joins and aggregations, with API key management handled via .env files for security.

Conclusion & Future Enhancements

This project successfully delivers a comprehensive system for pizza sales analytics, demonstrating expertise across database design, SQL implementation, data analysis, and AI engineering. It stands as a testament to interdisciplinary collaboration.

→ Successful System Delivery

A robust system integrating relational database principles and AI for pizza sales analytics.

→ Demonstrated Expertise

Showcased skills in database management, SQL development, and AI integration.

→ Future Enhancements

Potential for real-time data ingestion and advanced machine learning for predictive analytics.

We extend our sincere thanks to instructor Nargiza Zhumalieva for her invaluable guidance throughout this project.

