

Personalized Recommendation in Used Markets Using Multi-Agent Orchestration

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Research Motivations

Secondhand marketplaces require buyers to simultaneously evaluate a diverse set of factors — including **seller reliability, product condition, and price fairness** — and novice users often face **difficulty making well-informed decisions based solely on the limited information** provided by the platform.

The **ReCo Agent** addresses this challenge by systematically analyzing these multifaceted decision variables and generating personalized matches between users and the most suitable sellers and items.

Methodology

Interaction-based Matching Recommendation

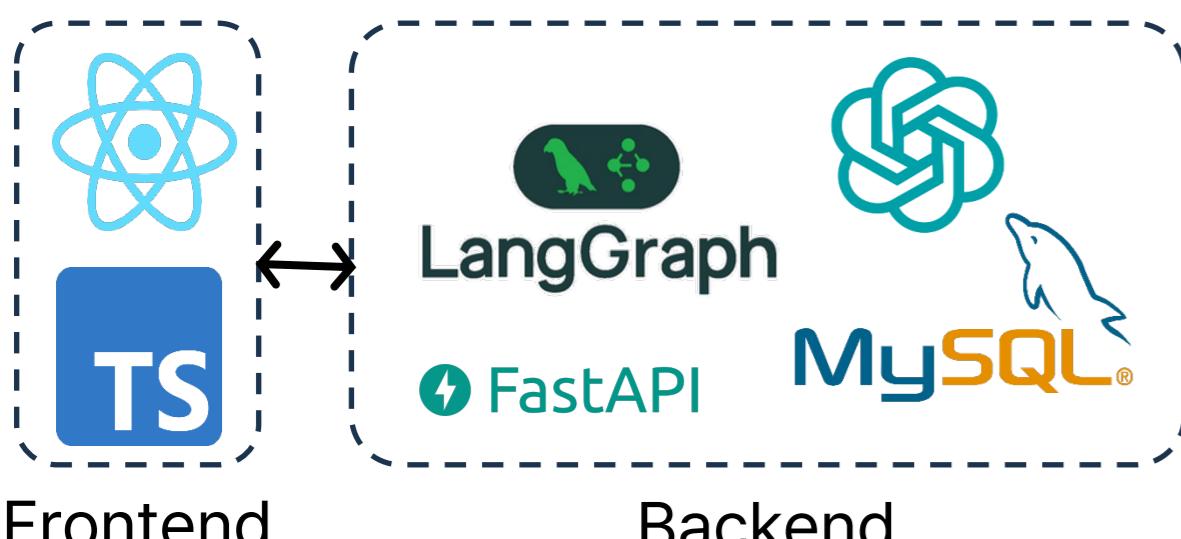
A buyer-seller interaction graph is used to derive relational similarity, enabling seller and listing recommendations without explicit purchase data.

Recommendation System using Multi-Agent Orchestration

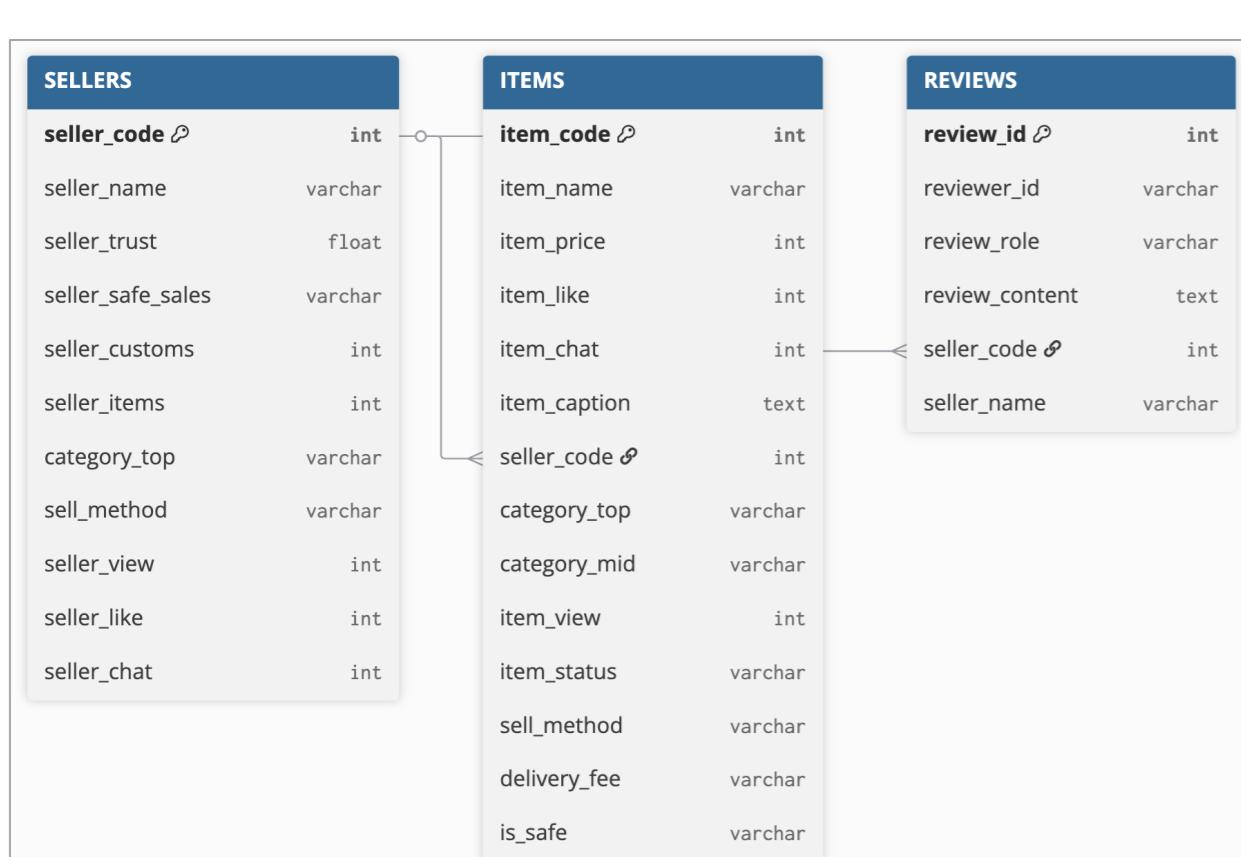
Multi-agent architecture is used where specialized agents independently analyze price, safety, and seller factors. Orchestrator integrates their outputs ensuring consistent reasoning and scalable operation.

System Development

System Architecture



Database Architecture



Entity Relationship Diagram

Agent Interface Component

Input

- Natural language search query
- Optional filters (category, location, price range)

Output

- Ranked list of sellers
- Natural language explanations

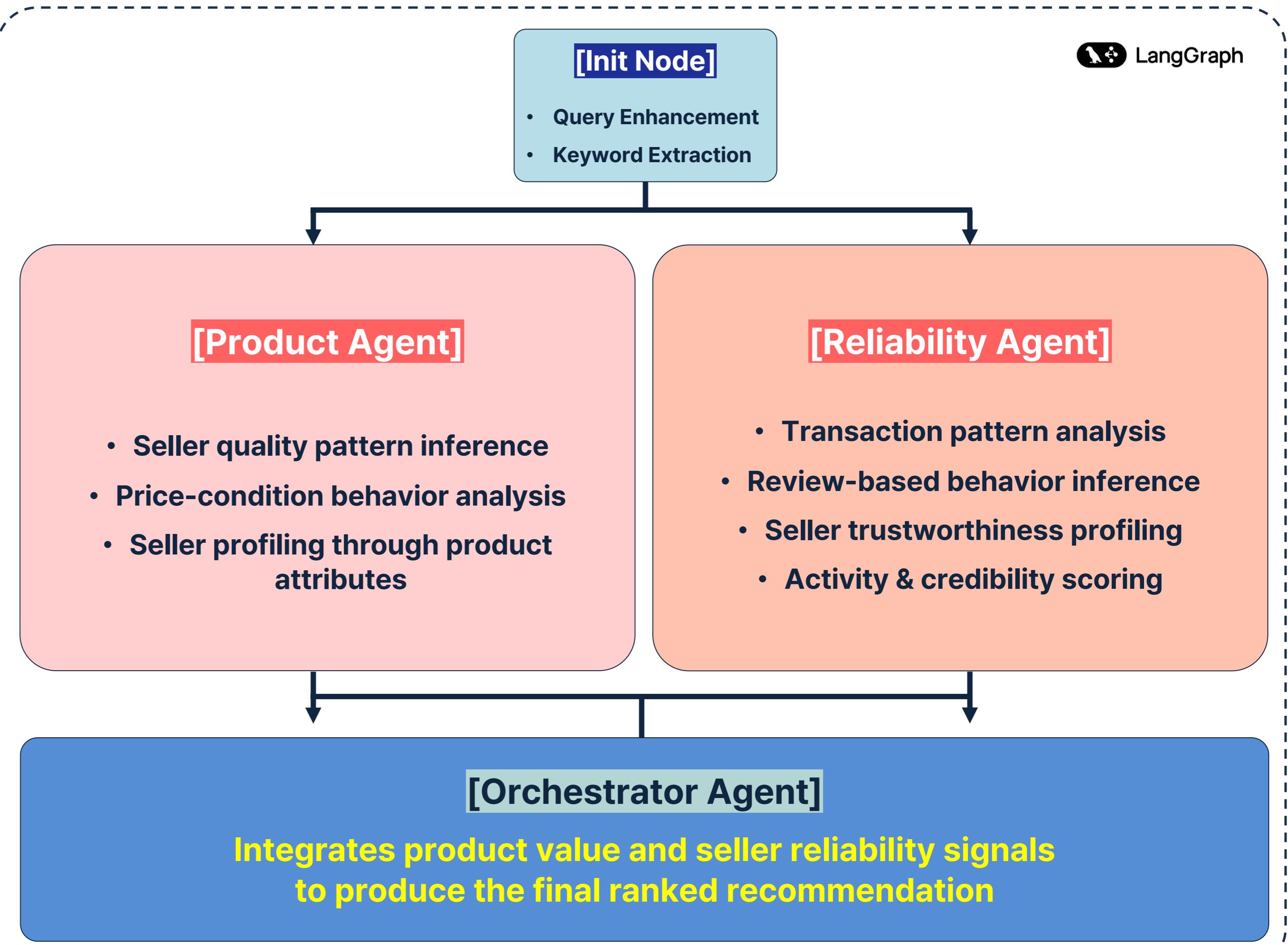
State

- Initial State: Raw user input only
- Parsed Query State: Normalized search query extracted by Init Node
- Agent Output State: Product & Reliability Agent recommendations populated
- Final Recommendation State: Ranked sellers and items with explanations

Limitations

- Variability and reliability constraints inherent to LLM-based inference
- Limited empirical evaluation owing to the small dataset scale
- Absence of rigorously defined quantitative metrics for risk scoring

Agent Workflow



Product Agent analyzes item attributes and pricing behavior to infer a seller's value profile, and the **Reliability Agent** assesses transaction patterns, reviews, and trust signals.

Orchestrator Agent integrates these heterogeneous outputs and aligns them with user preferences to produce the final ranked recommendation with explanations.

This workflow demonstrates how multi-agent orchestration can enhance recommender systems by improving modularity, interpretability, and personalization beyond traditional single-model approaches.

Future Works

- Developing a hybrid fraud detection model and reinforcing risk assessment through statistical approaches
- Advancing large-scale embedding and retrieval optimization
- Enhancing user-driven personalized recommendation mechanisms