AI DRIVEN CART OPTIMIZER

Smarter Carts. Sharper Decisions. Sustainable Outcomes.


Pavithra Kannan


Jehoshaphat T. Abaya

Ever Faced These While Shopping Online?

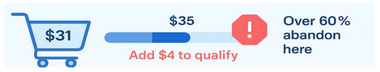
"I'm just a few dollars short of free shipping — what should I add?

"I don't want to waste money on random items just to avoid shipping fees."

"Why can't this site just tell me what I actually need?

Problem Statement

Over **60%[1]of online shoppers abandon their carts** when they fall short of free shipping minimums, resulting in lost revenue and poor customer experience. Although **93% of consumers[2]** are willing to add items to qualify, these additions are often random and inefficient. The **Smart Cart Optimizer,** powered by Deep Learning and Large Language Models (LLMs) recommends discounted, store-prioritized items based on user behavior and responds to customer queries in natural language. Achieving the lowest **RMSE (0.98)** and highest **AUC (0.9),** our solution boosts both savings for shoppers and inventory efficiency for retailers.



Without Optimizer	With Optimizer
Random item added	Store-prioritized item
Doesn't hit free shipping	Meets threshold efficiently
Low inventory turnover	Higher stock movement

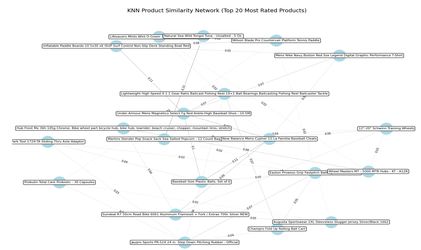
Optimize cart composition using machine earning to meet free shipping thresholds

Promote discounted, unsold items to reduce inventory waste and drive sales

Leverage LLMs to understand user queries and provide real-time insights

Align with retail sustainability goals through intelligent, data-driven recommendations

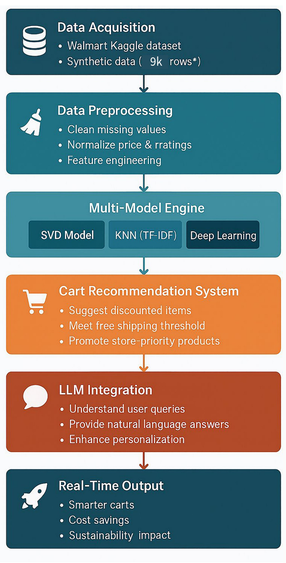
KNN Product Similarity Network



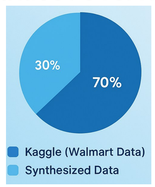
Methodology

The research utilized publicly available Walmart data from Kaggle[3], consisting of **30,000** records, supplemented with 9,000 synthetically generated entries to enhance model training, support advanced analytics, and simulate real-world scalability for recommendation and optimization scenarios.

Process Overview



Dataset Overview



ER Diagram

Model Selection

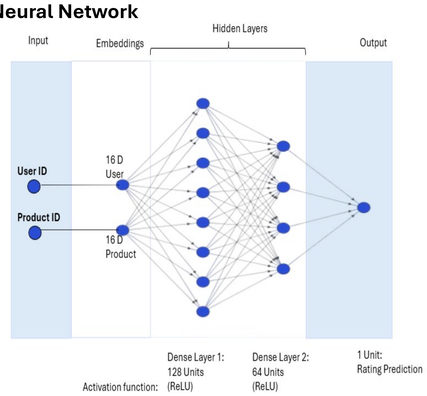
SVD (Collaborative Filtering)	KNN (Content-Based Filtering)	Deep Learning (Hybrid Recommender)	GenAI Integration (LLM)
Goal: Capture user–item interactions **Method:** Surprise library **Input:** User–item rating matrix	**Goal:** Match similar products **Method:** TF-IDF + Cosine Similarity **Input:** Product descriptions, categories, brands	**Architecture:** Neural Collaborative Filtering (NCF) **Layers:** Embedding → Dense → Concatenation **Input:** User and product embeddings	**Goal:** Enable natural language interaction **Model:** GPT-3.5 Turbo **Functionality:** Context-aware, real-time responses

Tech Stack

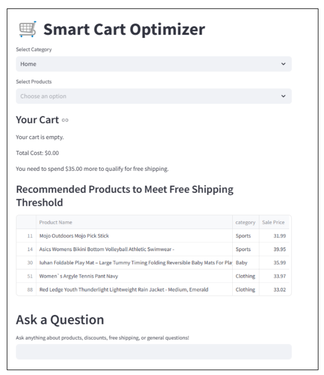
Streamlit · python · OpenAI · NumPy · scikit-learn · XGBoost · Surprise · pandas

Model Development

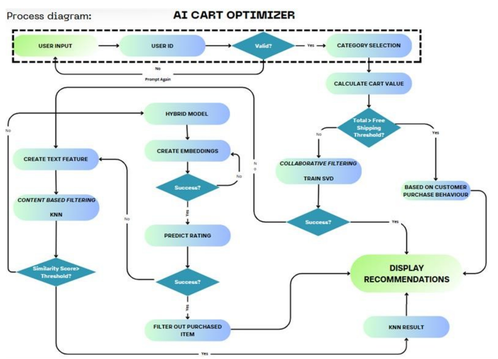
Multi Layered Deep Learning Neural Network



Solution Overview

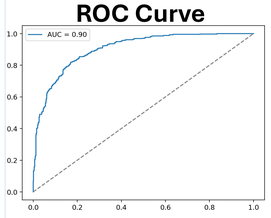


Process Diagram

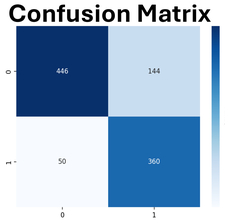


Benchmarking & Evaluation

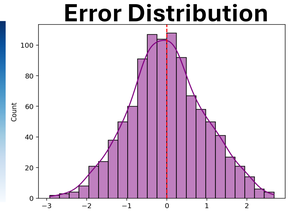
ROC Curve



Confusion Matrix



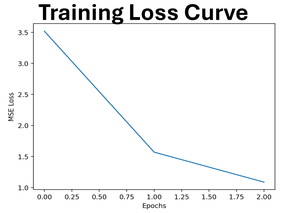
Error Distribution



Model Comparison Table

	Metric	Deep Learning	SVD	KNN (TF-IDF)*	XGBoost
0	RMSE	0.98	1.37	1.43	1.4
1	MAE	0.78	1.18	1.22	1.16
2	AUC	0.9	0.5	0.5	0.51

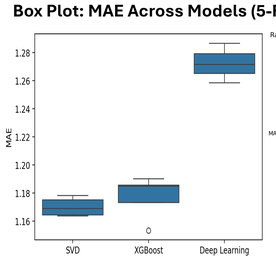
Training Loss Curve

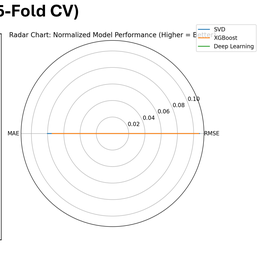


Hybrid deep learning model outperformed traditional methods (SVD, KNN, XGBoost), achieving an AUC of 0.90, with a **40% boost in accuracy**, **lower error rates** (RMSE: 0.98, MAE: 0.78), and a **20% drop in recommendation errors.**

Cross Validation

Box Plot: MAE Across Models (5-Fold CV)





K-Fold Cross-Validation was applied, with the deep learning model achieving the best performance (RMSE: 0.98, AUC: 0.90), demonstrating strong generalization and predictive accuracy. LLM successfully handled natural language queries like*:*

"What can I add to get free shipping?"

"Suggest low-cost essentials"

Reference

1. SellersCommerce. (2025). *Cart Abandonment Statistics You Should Know.* Retrieved from https://www.sellerscommerce.com/blog/abandoned-cart-statistics/

2.Capital One Shopping Research. (2024). *Free Shipping Statistics: How Far Will Shoppers Go?* Retrieved from https://capitaloneshopping.com/research/free-shipping-statistics

3.PromptCloud. (2019). *Walmart Product Data* [Data set]. Kaggle. https://www.kaggle.com/datasets/promptcloud/walmart-product-data

Lower Cart Abandonment Reduce cart abandonment by 50%

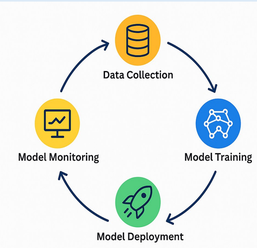
Higher AOV Increase in sales by 20%

Business Impact

Push Priority Items Reduces waste in 60% of suggestions, aligning with zero-waste principles

Saved Time Reduce shopper's time by 40%

Lifecycle Management & Next Steps



Next Steps

- Real-Time Adaptive Learning
- Sustainability Dashboard
- Mobile App Integration

Conclusion

Hybrid approach; collaborative filtering, deep learning, and LLMs.

Optimizes cart value to unlock free-shipping, **potentially reducing cart abandonment rate.**

Personalized recommendations based on user behavior & store priorities.

Enables real-time AI-assistance, reducing decision time during checkout.

Promotes inventory efficiency and aligns with sustainability goals.