Groupon AI Deal Generator (AIDG) v2.5

Intelligent Extensions Proposal

Advanced Case Study: Contextual Personalization & Safe Exploration

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Executive Summary

This proposal presents an advanced design for Groupon's AI Deal Generator (AIDG) v2.5, focusing on two critical enhancements: contextual deal personalization and intelligent exploration of deal variants. The solution leverages cutting-edge machine learning techniques including Graph Neural Networks (GNNs) for dynamic merchant behavioral profiling and Contextual Bandits with Thompson Sampling for safe exploration.

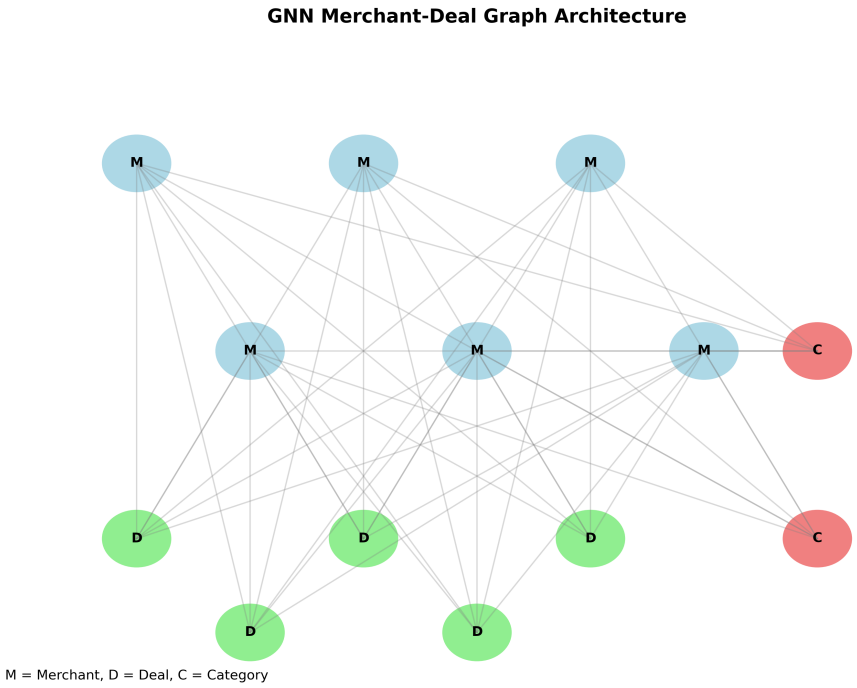
Key innovations include: • Graph-based merchant embeddings that capture complex behavioral patterns • Real-time personalization through modular microservices architecture • Bayesian exploration strategies with built-in safety mechanisms • Explainable AI components for stakeholder transparency • Continuous learning through feedback loops

1. Contextual Deal Personalization

The evolution of AIDG towards context-aware personalization requires sophisticated modeling of merchant behavioral profiles. This section details the technical approach for creating dynamic, explainable merchant representations that enable highly tailored deal suggestions.

1.1 Graph Neural Networks for Merchant Embeddings

Graph Neural Networks (GNNs) provide a powerful framework for modeling the complex relational data in Groupon's ecosystem. By constructing a heterogeneous merchant-deal graph, we can capture merchant behaviors within their network context.



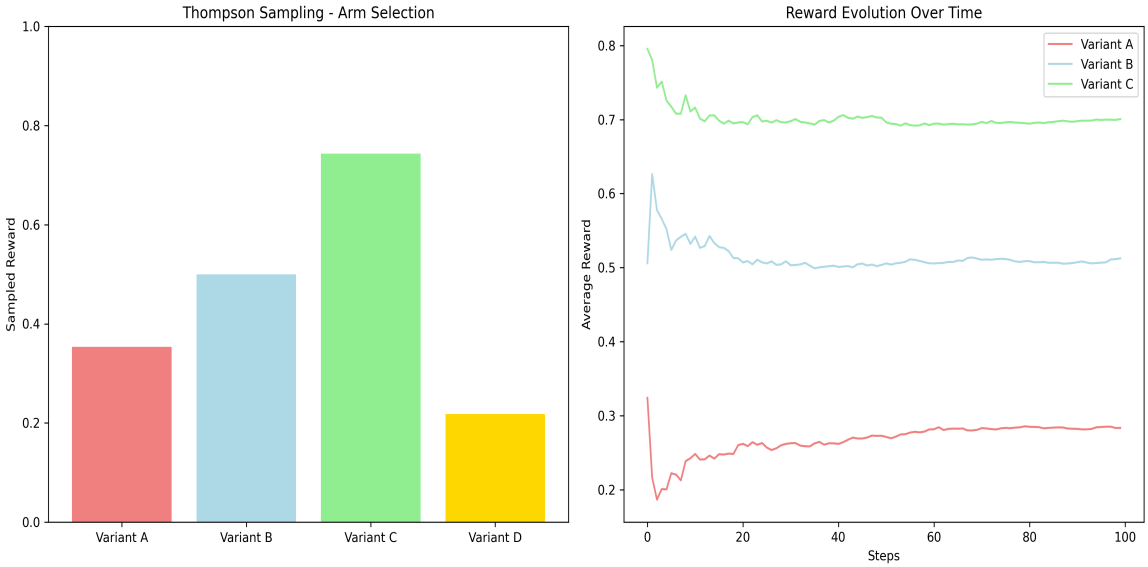
1.2 Feature Engineering Pipeline

The feature engineering pipeline processes multiple data sources into meaningful merchant representations. Key components include:

Data Source	Key Features	Processing Technique
Deal History	Temporal patterns, performance trends, discount elasticity	Time series analysis, rolling statistics
MM Overrides	Override frequency, change magnitude, seasonal trends	NLP topic modeling, delta analysis
Feedback Sentiment	Overall satisfaction, specific pain points, keyword extraction	Transformer-based sentiment analysis, aspect ext
Network Context	Similar merchant clusters, influence patterns	GNN message passing, attention mechanisms

2. Safe Exploration with Contextual Bandits

Balancing high-confidence suggestions with novel deal exploration is achieved through a Contextual Multi-Armed Bandit framework using Thompson Sampling. This approach provides principled exploration while maintaining safety through multiple guardrails.



2.1 Reward Signal Design

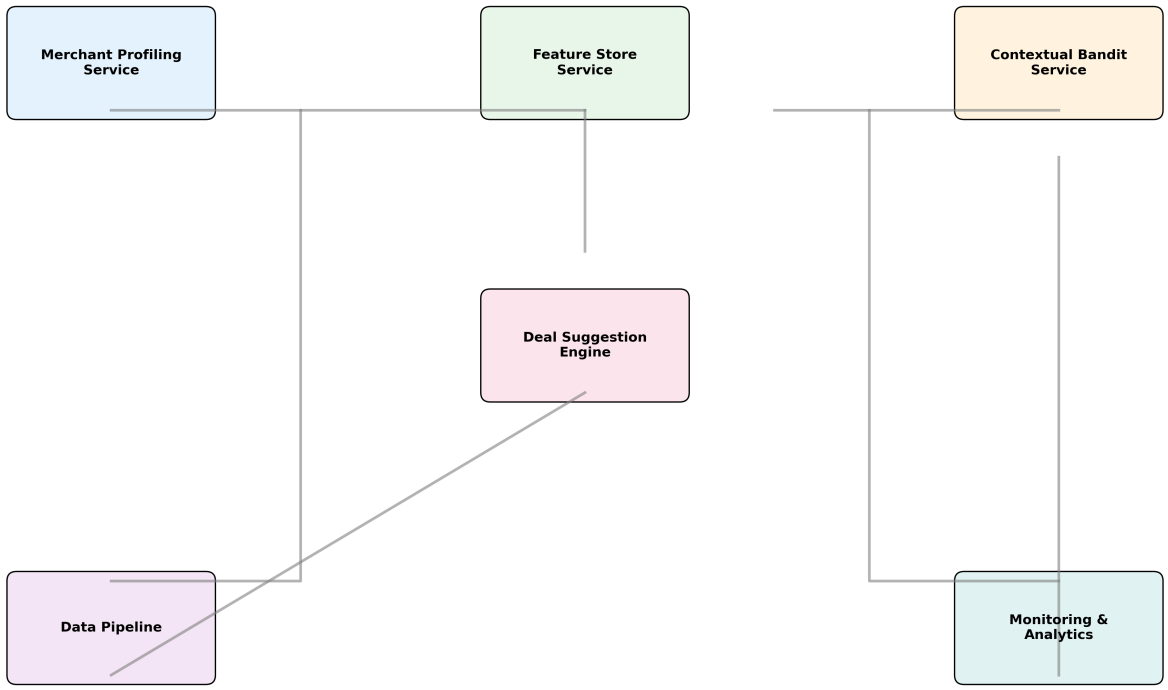
The composite reward function balances multiple objectives:

Component	Weight	Description
GP30 Uplift	40%	Direct financial impact measurement
MM Approval Rate	30%	Human expert validation signal
Conversion Proxy	20%	Leading indicator metrics (CTR, redemption)
Exploration Bonus	10%	Encourages novel variant testing

3. Production Architecture

AIDG v2.5 adopts a microservices architecture with clear separation of concerns, enabling independent scaling and continuous deployment of individual components.

AIDG v2.5 Microservices Architecture



3.1 Data Flow and Integration

The system implements a hybrid batch/streaming architecture: • Real-time data streams update merchant profiles within minutes • Batch processing handles heavy ML model retraining • Feature Store ensures consistency across training and inference • A/B testing framework enables safe experimentation

4. Evaluation and Success Metrics

Comprehensive evaluation ensures AIDG v2.5 delivers measurable business value while maintaining safety standards.

KPI	Target	Measurement
GP30 Uplift	+15% vs baseline	Controlled A/B tests
MM Override Rate	<20% within 90 days	Override tracking system
Merchant Satisfaction	NPS > 50	Quarterly surveys
System Latency	<200ms p95	Real-time monitoring
Exploration Success	20% novel variants adopted	Bandit performance metrics

4.1 Future Roadmap

Next evolution phases include: • Advanced RL agents for multi-step deal optimization • LLM integration for natural language explanations • Automated feature engineering with AutoML • Federated learning for privacy-preserving merchant insights • Quantum optimization for complex pricing scenarios

Conclusion

AIDG v2.5 represents a significant advancement in AI-driven deal generation, combining cutting-edge ML techniques with robust engineering practices. The proposed solution delivers personalized, context-aware deal suggestions while maintaining safe exploration through principled algorithms and comprehensive monitoring. The modular architecture ensures scalability and continuous improvement, positioning Groupon at the forefront of AI-powered merchant services.