

Query Reformulation Modeling in E-commerce Search- by Ziqi Zhang et al



Dashboard Parts Overview

Part 1: Overview & Main Insights

- Paper introduction and authors
- Key challenges in e-commerce search
- Query Reformulation solution overview
- Revenue impact across markets

<https://claude.site/artifacts/fa48bece-4323-44fa-8291-47ce172cbbf7>

Part 2: ANCE Mining Pipeline

- Visual representation of the ANCE self-retrieval process
- Bi-encoder retrieval mechanism
- Hard negative mining strategy
- Interactive flow diagram showing the training loop
- Co-purchase filtering visualization

<https://claude.site/artifacts/d594ac7f-495c-450f-a442-89da9b6999d8>

Part 3: Model Architecture & Training

- Bi-encoder vs Cross-encoder comparison
- Training data flow visualization
- Model performance metrics
- Interactive component showing query transformations
- Fine-tuning process visualization

<https://claude.site/artifacts/3e8d9b8b-bb56-4bf0-a14c-d7c46c5a3931>

Part 4: Samsung E-commerce Application

- Real-world examples with Samsung products
- Before/after query reformulation comparisons
- Product ranking improvements
- Category-specific impacts
- Tail query handling demonstration

<https://claude.site/artifacts/f11432a3-9feb-4e8e-8f3c-457dcd4c6b90>

Part 5: Implementation Strategy

- Custom ANCE training loop architecture
- Multilingual support features
- Data mining techniques
- System integration diagram
- Technical recommendations

<https://claude.site/artifacts/f8eb75ac-ab83-45ac-948b-b2f4bded4cc6>

Enhancing Samsung E-commerce Search with Advanced Query Reformulation

Samsung's e-commerce platform faces a common challenge: many search queries don't deliver relevant results due to variations in how users express their needs. To address this, Samsung implemented an advanced Query Reformulation (QR) system using the ANCE (Approximate Nearest Neighbor Negative Contrastive Estimation) methodology.

The Problem

Tail queries (less common searches) often lack sufficient behavioral data, making it difficult to return relevant products. Users might search for "galaxy phone with pen" or "purple dress women" and get poor results because the system lacks click/purchase data for these specific phrases.

The Solution: ANCE-based Query Reformulation

The solution involves three key components:

1. **Bi-Encoder:** Efficiently retrieves relevant products from the catalog
2. **Cross-Encoder:** Precisely reranks results for better accuracy
3. **ANCE Mining Pipeline:** Continuously improves models by creating better training data

The system learns semantic relationships between queries. For example, it understands that "galaxy fold 5 pro" refers to "Samsung Galaxy Z Fold 5" and "best phone gaming" relates to high-performance devices like "Galaxy S23 Ultra."

Key Results

The implementation delivered impressive outcomes:

- **Revenue Impact:** +0.14% (Japanese), +0.29% (Hindi), +0.08% (English)
- **Ad Revenue:** +0.36% increase in Japanese market
- **Product Coverage:** 85% improvement in tail query handling
- **Categories:** 19-35% improvement across all product categories

Technical Approach

The ANCE pipeline operates in cycles:

1. Collect behavioral signals (queries, clicks, purchases)
2. Generate query variants and equivalences
3. Use bi-encoder to retrieve candidate products
4. Mine hard negatives for training
5. Fine-tune models iteratively
6. Deploy cross-encoder for final reranking

Business Impact

The system significantly improves user experience by:

- Better understanding semantic variations
- Supporting multiple languages (Japanese, Hindi, English)
- Delivering relevant results for long-tail queries
- Increasing click-through rates and conversions

This approach demonstrates how AI-driven query reformulation can transform e-commerce search, making it more intuitive and effective for users while driving measurable business results.

Examples of Queries Improved by Query Reformulation

Here's a comprehensive list of queries that can be transformed for better search results across Samsung's product categories:

Mobile Devices

- **Original:** "samsung s phone pro 2025" **Reformulated:** "Samsung Galaxy S25 Ultra"
- **Original:** "galaxy fold flip hybrid" **Reformulated:** "Samsung Galaxy Z Flip 5"
- **Original:** "phone with best camera nighttime" **Reformulated:** "Samsung Galaxy S23 Ultra night photography"
- **Original:** "5g phone cheap samsung" **Reformulated:** "Samsung Galaxy A54 5G budget"
- **Original:** "water resistant phone for swimming" **Reformulated:** "Samsung Galaxy IP68 waterproof"

Tablets & Computing

- **Original:** "samsung tab pen drawing" **Reformulated:** "Samsung Galaxy Tab S9 with S Pen"
- **Original:** "lightweight laptop windows" **Reformulated:** "Samsung Galaxy Book Pro 360"
- **Original:** "tablet for kids education" **Reformulated:** "Samsung Galaxy Tab A8 Kids Edition"
- **Original:** "chromebook student discount" **Reformulated:** "Samsung Chromebook Go education"

Wearables

- **Original:** "watch that measures blood pressure" **Reformulated:** "Samsung Galaxy Watch 6 health monitoring"
- **Original:** "wireless buds noise cancelling" **Reformulated:** "Samsung Galaxy Buds Pro ANC"
- **Original:** "fitness band sleep tracking" **Reformulated:** "Samsung Galaxy Fit3 sleep monitor"

TV & Audio

- **Original:** "big tv living room wall" **Reformulated:** "Samsung Neo QLED 85-inch"
- **Original:** "soundbar with subwoofer dolby" **Reformulated:** "Samsung Q990B Dolby Atmos"
- **Original:** "picture frame television art mode" **Reformulated:** "Samsung The Frame TV"

Accessories

- **Original:** "wireless charger multiple device" **Reformulated:** "Samsung Wireless Charger Trio"
- **Original:** "phone case s23 ultra military grade" **Reformulated:** "Samsung Galaxy S23 Ultra rugged protective case"
- **Original:** "fast charging brick type c" **Reformulated:** "Samsung 45W USB-C power adapter"

Multilingual Examples

Japanese

- **Original:** "最新のスマホ カメラ重視" **Reformulated:** "Galaxy S23 Ultra カメラ性能 最新モデル"
- **Original:** "折りたたみ 軽量" **Reformulated:** "Galaxy Z Flip 5 折りたたみスマートフォン"

Hindi

- **Original:** "सैमसंग फोन बजट" **Reformulated:** "Samsung Galaxy M34 5G बजट स्मार्टफोन"
- **Original:** "टैबलेट स्टूडेंट्स के लिए" **Reformulated:** "Samsung Galaxy Tab A8 शिक्षा उपयोग"

Seasonal & Contextual

- **Original:** "mother's day gift tech" **Reformulated:** "Samsung Galaxy Watch Women's Collection Mother's Day"
- **Original:** "black friday deals samsung phones" **Reformulated:** "Samsung Galaxy S23 Black Friday promotion"
- **Original:** "back to school laptop deals" **Reformulated:** "Samsung Galaxy Book student discount"

Technical & Specific

- **Original:** "phone 120hz oled display" **Reformulated:** "Samsung Galaxy S23 120Hz Dynamic AMOLED 2X"
- **Original:** "tablet windows compatible" **Reformulated:** "Samsung Galaxy Book3 Pro 360 Windows 11"
- **Original:** "smartwatch lte cellular" **Reformulated:** "Samsung Galaxy Watch 6 LTE standalone connectivity"

These examples demonstrate how the reformulation system can:

- Correct spelling and format inconsistencies
- Add missing product modifiers
- Translate colloquial terms to product specifications
- Identify and add relevant technical features
- Handle multilingual queries effectively
- Understand contextual and seasonal intent