OVERVIEW OF THE TREC 2023 PRODUCT PRODUCT SEARCH TRACK

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ABSTRACT

This is the first year of the TREC Product search track. The focus this year was the creation of a reusable collection and evaluation of the impact of the use of metadata and multi-modal data on retrieval accuracy. This year we leverage the new product search corpus, which includes contextual metadata. Our analysis shows that in the product search domain, traditional retrieval systems are highly effective and commonly outperform general-purpose pretrained embedding models. Our analysis also evaluates the impact of using simplified and metadata-enhanced collections, finding no clear trend in the impact of the expanded collection. We also see some surprising outcomes; despite their widespread adoption and competitive performance on other tasks, we find single-stage dense retrieval runs can commonly be noncompetitive or generate low-quality results both in the zero-shot and fine-tuned domain.

1 Introduction

At TREC 2023, we hosted the first TREC Product Search Track, looking to create a reusable general benchmark for evaluating the performance of retrieval methods in the product search domain. We focus on providing a benchmark similar in scale and format to NQ Kwiatkowski et al. [2019], or the Deep Learning Track Craswell et al. [2021] but focused on product search. In providing a simple-to-use dataset, we believe broad experimentation using popular retrieval libraries Lin et al. [2021] Gao et al. [2022] can lead to broad improvements in retrieval performance.

In this first year of the track, we created a novel collection based on the ESCI Product Re-ranking dataset Reddy et al. [2022], sampled novel queries, created enriched metadata in the form of additional text and images along with seeded evaluation results with a broad range of baseline runs to aid in collection reusability and to allow iteration and experimentation on the use of additional context.

Unlike previous product search corpora, the Product Search Track is multi-modal and has a large enough scale to explore the usage of neural retrieval methods. We observe somewhat surprising results using this scaled dataset and a wide variety of baseline runs. Single-stage retrieval models that leverage vector representations do not consistently outperform traditional retrieval methods such as BM25. Moreover, in the zero-shot setting, we find that larger vector-based models do not always beat their more minor variants, which is at odds with other evaluation corpora such as MTEB Muennighoff et al. [2023]. Finally, while additional metadata can improve retrieval performance at a macro level, extra information cannot guarantee performance. In evaluating per-query performance, we find that vector-based systems lose performance with the other metadata. Please see the participant papers for more insights about what we learned this year.

2 Task description

The product search track has one task: product ranking. Within this task, various enriched datasets are opened to participants to allow them to enrich the collection as they see fit. Participants were allowed to submit up to three

Product Search Query Generation

Below is an instruction that describes a task, paired with an input that provides further context.
Write a response that appropriately completes the request

Instruction:

You are part of a search engine that helps users find relevant products given their queries.
Artificial queries must be generated as part of an effort to improve the relevance of retrieval methods.
Read the product description and title and write a query that a user would issue if they would seek to access the product mentioned below. Provide reasoning for your generation.

Consider the following factors when generating the query:
1. Does this product fully meet the needs of the query?
2. Does this query seek a specific product that could only be met by this given product?

Respond in JSON where the generated query has the key "query" and the reasoning has the key "reasoning"

Input:

product:{$product$**}**

Response:

Figure 1: Prompt used in our synthetic query generation on randomly selected product. The sampled product is included in the placeholders $\{product\}$.

official runs. When submitting each run, participants indicated what external data, pretrained models, and other resources were used, as well as information on what style of the model was used.

In the ranking task, given a query, the participants were expected to retrieve a ranked list of products from the full collection based on the estimated likelihood that the product would meet the user's need. Participants could submit up to 100 products per query for this end-to-end ranking task.

We first selected a subset of 200 queries for judging in the pooling and judging process. Then NIST started judging these queries, throwing out queries without high disagreement or deemed un-judgable. If at least 50% of the judged products are relevant or there is no relevant product, the query is deemed un-judgable. This led to a judged test set of 186 queries, which we compare the quality of runs. The track received 62 submissions to the passage ranking task, 39 of which were baseline runs that the track coordinators submitted.

Judgments were collected for each query product pair on a four-point scale:

[3] **Perfectly relevant:** The product is exactly what the user wants.

[2] **Highly relevant:** The product could match the user query, but it may be a substitute for the original query intent. It may have a slightly different style, brand, or type, but a user would be satisfied if they received this product.

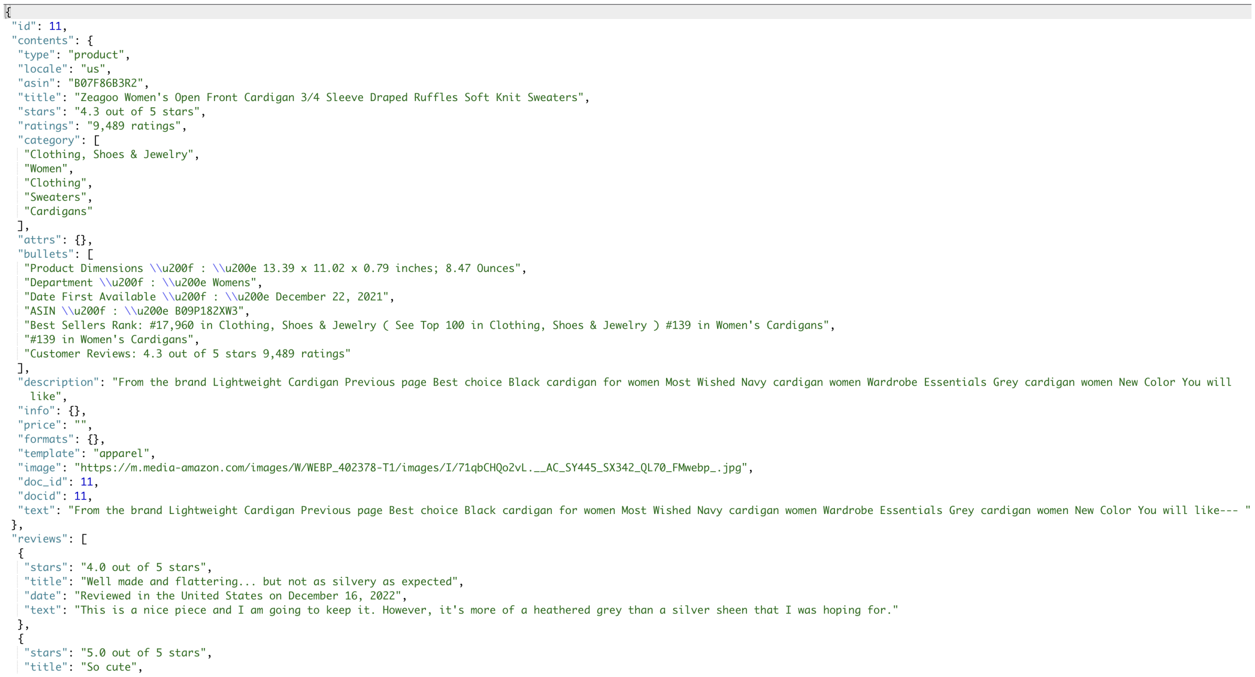
[1] **Related:** The product seems related to the query but not the item the user seeks. Products in this category could complement the user's intended product.

[0] **Irrelevant:** The product has nothing to do with the query.

For binary metrics, we map judgment levels 3,2 to relevant and 1,0 to irrelevant.

The collection is based on the ESCI Shopping queries dataset Reddy et al. [2022]. While this dataset is focused on improving product search, it lacks a clear end-to-end retrieval benchmark. Instead, the dataset includes a re-ranking task in which the top 40 results retrieved from the Amazon product corpus must be re-ranked for improved relevance. While this re-ranking task is quite important to the end-to-end performance of a product search engine, it does not allow for ample understanding of what impacts the performance of end-to-end retrieval in the product domain.

Since there is no source of publicly available shopping queries, nor does the ESCI dataset have a publicly accessible test dataset, we created a new set of 998 evaluation queries leveraging GPT-4 and some heuristic-based sampling. For query generation, we leveraged GPT-4 along with Prompt, which built on the work of InPars Bonifacio et al. [2022] Jeronymo et al. [2023], and we created 500 queries using the prompt shown in table 1.



```
{
 "id": 11,
 "contents": {
  "type": "product",
  "locale": "us",
  "asin": "B07F86B3R2",
  "title": "Zeagoo Women's Open Front Cardigan 3/4 Sleeve Draped Ruffles Soft Knit Sweaters",
  "stars": "4.3 out of 5 stars",
  "ratings": "9,489 ratings",
  "category": [
   "Clothing, Shoes & Jewelry",
   "Women",
   "Clothing",
   "Sweaters",
   "Cardigans"
  ],
  "attrs": {},
  "bullets": [
   "Product Dimensions \\u200f : \\u200e 13.39 x 11.02 x 0.79 inches; 8.47 Ounces",
   "Department \\u200f : \\u200e Womens",
   "Date First Available \\u200f : \\u200e December 22, 2021",
   "ASIN \\u200f : \\u200e B09P182XW3",
   "Best Sellers Rank: #17,960 in Clothing, Shoes & Jewelry ( See Top 100 in Clothing, Shoes & Jewelry ) #139 in Women's Cardigans",
   "#139 in Women's Cardigans",
   "Customer Reviews: 4.3 out of 5 stars 9,489 ratings"
  ],
  "description": "From the brand Lightweight Cardigan Previous page Best choice Black cardigan for women Most Wished Navy cardigan women Wardrobe Essentials Grey cardigan women New Color You will
    like",
  "info": {},
  "price": "",
  "formats": {},
  "template": "apparel",
  "image": "https://m.media-amazon.com/images/W/WEBP_402378-T1/images/I/71qbCHQo2vL.__AC_SY445_SX342_QL70_FMwebp_.jpg",
  "doc_id": 11,
  "docid": 11,
  "text": "From the brand Lightweight Cardigan Previous page Best choice Black cardigan for women Most Wished Navy cardigan women Wardrobe Essentials Grey cardigan women New Color You will like--- "
 },
 "reviews": [
  {
   "stars": "4.0 out of 5 stars",
   "title": "Well made and flattering... but not as silvery as expected",
   "date": "Reviewed in the United States on December 16, 2022",
   "text": "This is a nice piece and I am going to keep it. However, it's more of a heathered grey than a silver sheen that I was hoping for."
  },
  {
   "stars": "5.0 out of 5 stars",
   "title": "So cute",
```

Figure 2: Each product in the collection contains basic information such as a title and product description along with contextual metadata, which includes attributes such as reviews, dimensions, etc.

Figure 3: Some examples of product images. Some items have multiple images, while others have none.

To avoid cases where this approach fails and to study how models perform with more typical product search queries with high keyword overlap, we generate queries by selecting sub-spans of product titles or descriptions. In generating queries with GPT-4, we aimed to create a reliable way of generating new and interesting queries for the collection, as we do not have a method to sample novel queries reliably.

3 Datasets

This year, we leverage an enriched and filtered product search dataset based on the ESCI dataset Reddy et al. [2022]. We will first describe the dataset and its generation before we describe how we adapted it to best suit the track.

Shopping Queries Dataset: A Large-Scale ESCI Benchmark for Improving Product Search The benchmark for improving product search, or ESCI, is a large-scale benchmarking dataset that focuses on subsets of product search use cases and provides frameworks from which improvement can be studied. Unlike other product retrieval datasets, the ESCI corpus contains English, Japanese, and Spanish queries.

The dataset centers around three tasks important to the world of product search. It can be used to improve customer experience: Query-Product Ranking, Multi-class Product Classification, and Product Substitute Identification. For Query-Product Ranking: given a user-specified query and the top 40 products retrieved by a commercial product search engine, this task aims to rank the products to have more relevant products ranked above non-relevant products. For Multi-class Product Classification: given a query and a result of products, classify products into the following matches: Exact, substitute, complement, and irrelevant. For Product Substitute Identification: given a product and a

list of potential substitutes, identify which could be substituted.
Within the three tasks, there are two variants of product collections, with the product ranking task using the smaller collection and the other tasks using a larger task. Given our focus on retrieval, we leverage the former. Within each task, there is a large training data set that contains query product pairs that have been annotated as exact match (E), substitute (S), complement (C), and irrelevant (I). The data contains the following fields: example id, query, query id, product id, product locale, ESCI label, small version, large version, split, product title, product description, product bullet point, product brand, product color, and source.
The smaller ranking dataset has 48,300 unique queries and 1,118,011 relevance judgments. The data sets are stratified into train, dev, and test, of which only the labels for the train and dev have been released publicly. On average, each query has 20 judgments for English and 28 for other languages.

Item	Instances	Notes
Collection	1,661,907	90+% of products have at least 1 image
Train Queries	30,734	Train + Dev
Train QREL	392,119.00	N/A
2023 Test Queries	926	N/A
2023 Test Queries (Judged)	182	N/A

Table 1: High-level statistics on the size of the collection and queries of the TREC Product Search 2023 Collection

Product Search Track Corpus While the full ESCI dataset is multilingual and features over 3 million items, we narrowed our focus to English only. We attempt to enrich the dataset with additional Metadata and images for these English products as we believe this can be very important for product search. The ESCI dataset is focused on text information that ignores any behavioral, categorical, visual, or numerical features that can be used for ranking. Product metadata enrichment improves product representations by including additional helpful information such as reviews, attributes such as size and color, and categorical ordering from extracted Metadata from Amazon's online catalog [1]. Figure 2 shows an example product with its additional Metadata. We crawled and removed images for each product using the ASIN from this enrichment. Product images contain one to ten thumbnail-size images for a given product, which were shuffled from Amazon and joined with the ESCI dataset. Since these images are extracted from product thumbnails, each image is only 64x64, which allows the entire collection to be relatively small. Some product image examples can be found in figure 3. Numerical details on the collection can be found in table 1

4 Results and analysis

Submitted runs A total of 4 groups participated in the TREC 2023 Product Search Track, including baseline runs submitted by the track coordinators. Across all groups, we received 62 run submissions, including 49 baseline runs. Table 2 and figure 4 summarizes the submission statistics for this year's track. This set of runs led to 182 evaluated queries, which we believe will likely make this a highly reusable collection apt for future experimentation.

This year, we had fewer participating groups than we hoped for compared to similar tracks (Deep learning had 15 groups in 2019, 25 in 2020, and 19 in 2021). We believe this might indicate the broader saturation of the IR community by large-scale datasets focused on single-stage retrieval via neural language models.

Overall results Table 3 presents a standard set of relevance quality metrics for product search ranking runs. Reported metrics include Normalized Discounted Cumulative Gain (NDCG) [Järvelin and Kekäläinen, 2002] at depth 10 and 100, Recall at depth 10 and 100, and the Infrared Average Precision (InfAP) [Yilmaz and Aslam, 2006]. Results represent the mean score across the 182 queries that NIST assessed, and scores are computed using TRECEVAL.

[1] Metadata was extracted from https://github.com/shuttie/esci-s/

Table 2: TREC 2023 Product Search Track run submission statistics.

	All Groups	**Coordinator Baselines**
Number of groups	4	1
Number of total runs	62	39

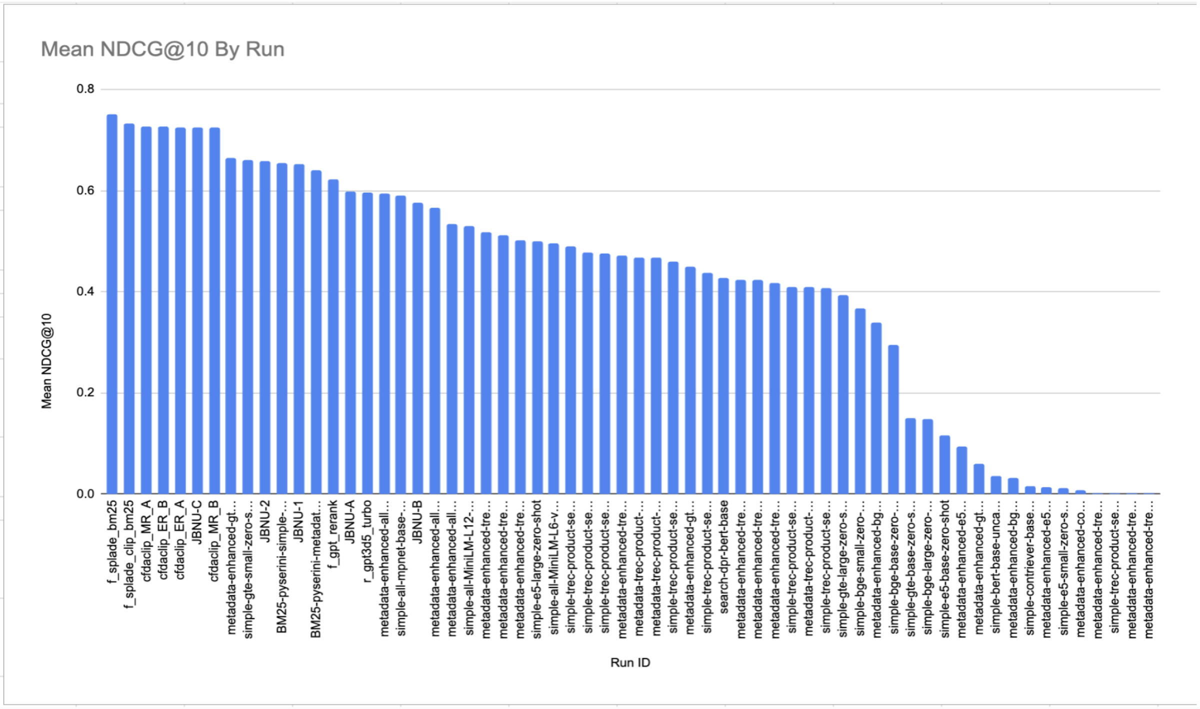


Figure 4: Relative system ordering based on mean NDC@10

None of these results leverage the existing development portion of ESCI or the unreleased eval set. In subsequent discussions, we employ NDCG@10 as our primary evaluation metric to analyze the ranking quality produced by different methods.

To analyze how different approaches perform in the high recall domain, we employ recall at 100 (R@100), which compares how often the positive set is present in the top 100 candidates even if they are not often ranked highly. In the product search, users often add sorting and filtering forms via price, size, color, etc. When a user removes portions of the ranked candidate set, the recall of a larger filter set becomes highly important.

Looking at the results in table 3, we see clear gains from hybrid retrieval systems that leverage multiple retrievers to improve performance (f_splade_bm25,cfdaclip_MR_A). We further see that in this domain, there is a consistent and effective performance for traditional retrieval methods such as BM25, which is one of the top-performing systems despite a lack of collection optimization.

When we evaluate specific queries as shown in table 4, we find that there are some queries, such as *Elite (Elite) Volano/drivo/Kura For Body 329770001* or *small measuring rice bin Asvel* or *Dinosaur Pee Pee Teepee Wee*, where one or a few retrieval systems have high NDCG@10 scores. In contrast, most systems have scores of 0. Each of these queries is looking for specific items, and surprisingly, the systems that excel at spear-fishing each product are inconsistent across questions.

Performance on long *vs.* short queries To better understand the variance between variations in query length, we stratified the queries based on query length to analyze whether system ordering depends on query length. We study this because shorter queries, such as *Google Wi-Fi System Mesh*, tend to be more broad in the world of product search. In contrast, longer queries, such as **21x21 beige sun shade sail patio UV protection outdoor backyard**, focus on finding specific products. We stratify queries by setting queries with 7 or more words that are too long and everything else assorted. This leaves 182 total queries, 81 short queries, and 101 long queries. When we use these stratified sets of queries, we find high Kendall tau with 0.93442 (7.13e-27) and 0.9640 (1.70e-28) for short and long, respectively. This agreement is surprisingly high as we see a large variation in NDCG as shown in table 11 where, for example, with BM25, the NDCG@10 from long to short queries is > 10% relative move.

Metadata *vs.* Simple Collection To understand the impact of enriching the collection with textual metadata in our baselines, we provided runs that use the simple collection and enhanced metadata. Tables 5 and 6 provide detailed

Table 3: Summary of results for all runs.

Run	Group	InfAP	NDCG @10	NDCG @100	R@10	R@100
f_splade_bm25	F	0.6068	0.7505	0.7244	0.4919	0.8015
f_splade_clip_bm25	F	0.5731	0.7327	0.7143	0.4739	0.8001
cfdaclip_MR_A	JBNU	0.5910	0.7257	0.7019	0.4766	0.7857
cfdaclip_ER_B	JBNU	0.5905	0.7256	0.7010	0.4766	0.7862
cfdaclip_ER_A	JBNU	0.5902	0.7252	0.7008	0.4765	0.7840
JBNU-C	JBNU	0.5885	0.7251	0.7074	0.4700	0.7870
cfdaclip_MR_B	JBNU	0.5903	0.7251	0.7010	0.4765	0.7859
metadata-enhanced-gte-small-zero-shot	Baselines	0.4955	0.6647	0.6500	0.4363	0.7416
simple-gte-small-zero-shot	Baselines	0.4818	0.6612	0.6492	0.4375	0.7372
JBNU-2	JBNU	0.4792	0.6583	0.6208	0.4359	0.7272
BM25-pyserini-simple-collection	Baselines	0.4769	0.6540	0.6148	0.4287	0.7241
JBNU-1	JBNU	0.4828	0.6531	0.6185	0.4092	0.7272
BM25-pyserini-metadata-collection	Baselines	0.4729	0.6408	0.6160	0.4254	0.7272
f_gpt_rerank	F	0.4673	0.6225	0.6599	0.3765	0.8001
JBNU-A	JBNU	0.4500	0.5989	0.5607	0.3772	0.6636
r_gpt3d5_turbo	r	0.4174	0.5950	0.5889	0.3806	0.7272
metadata-enhanced-all-mpnet-base-v2-zero-shot	Baselines	0.4144	0.5937	0.5541	0.3862	0.6512
simple-all-mpnet-base-v2-zero-shot	Baselines	0.4000	0.5895	0.5508	0.3806	0.6348
JBNU-B	JBNU	0.4349	0.5763	0.5380	0.3580	0.6339
metadata-enhanced-all-MiniLM-L12-v2-zero-shot	Baselines	0.3844	0.5660	0.5309	0.3821	0.6558
metadata-enhanced-all-MiniLM-L6-v2-zero-shot	Baselines	0.3688	0.5328	0.5164	0.3654	0.6415
simple-all-MiniLM-L12-v2-zero-shot	Baselines	0.3483	0.5288	0.5161	0.3502	0.6365
metadata-enhanced-trec-product-search-gte-small	Baselines	0.3520	0.5168	0.5101	0.3443	0.5859
metadata-enhanced-trec-product-search-e5-small-v2	Baselines	0.3488	0.5119	0.5082	0.3481	0.6096
metadata-enhanced-trec-product-search-gte-base	Baselines	0.3423	0.5009	0.5004	0.3400	0.5895
simple-e5-large-zero-shot	Baselines	0.3339	0.4998	0.4490	0.3428	0.5537
simple-all-MiniLM-L6-v2-zero-shot	Baselines	0.3261	0.4952	0.4924	0.3334	0.6099
simple-trec-product-search-gte-small	Baselines	0.3194	0.4901	0.4902	0.3080	0.5692
simple-trec-product-search-gte-base	Baselines	0.3067	0.4777	0.4813	0.3123	0.5676
simple-trec-product-search-all-miniLM-L12-v2	Baselines	0.3060	0.4763	0.4589	0.3100	0.5351
metadata-enhanced-trec-product-search-bge-small-en	Baselines	0.3193	0.4721	0.4708	0.3012	0.5565
metadata-trec-product-search-all-miniLM-L12-v2	Baselines	0.3129	0.4681	0.4603	0.3081	0.5581
metadata-trec-product-search-all-miniLM-L6-v2	Baselines	0.3144	0.4673	0.4675	0.3181	0.5528
simple-trec-product-search-all-miniLM-L6-v2	Baselines	0.3008	0.4591	0.4599	0.2931	0.5429
metadata-enhanced-gte-large-zero-shot	Baselines	0.2503	0.4501	0.4103	0.2698	0.4978
simple-trec-product-search-bge-small-en	Baselines	0.2726	0.4379	0.4328	0.2741	0.5080
search-dpr-bert-base	Baselines	0.2648	0.4272	0.4333	0.2796	0.5068
metadata-enhanced-trec-product-search-e5-base-v2	Baselines	0.2703	0.4242	0.4118	0.2793	0.5148
metadata-enhanced-trec-product-search-bge-base-en	Baselines	0.2709	0.4237	0.4165	0.2938	0.4955
metadata-enhanced-trec-product-search-dpr-bert	Baselines	0.2636	0.4165	0.4276	0.2774	0.5208
simple-trec-product-search-all-mpnet-base-v2	Baselines	0.2377	0.4090	0.4013	0.2507	0.4747
metadata-trec-product-search-all-mpnet-base-v2	Baselines	0.2611	0.4089	0.4118	0.2643	0.5006
simple-trec-product-search-bge-base-en	Baselines	0.2448	0.4064	0.4027	0.2628	0.4728
simple-gte-large-zero-shot	Baselines	0.2146	0.3930	0.3654	0.2319	0.4294
simple-bge-small-zero-shot	Baselines	0.1898	0.3680	0.3475	0.2059	0.4188
metadata-enhanced-bge-base-en-zero-shot	Baselines	0.1919	0.3396	0.3290	0.2211	0.4301
simple-bge-base-zero-shot	Baselines	0.1178	0.2948	0.2458	0.1479	0.2664
simple-gte-base-zero-shot	Baselines	0.0522	0.1493	0.1131	0.0581	0.0965
simple-bge-large-zero-shot	Baselines	0.0498	0.1486	0.1056	0.0537	0.0787
simple-e5-base-zero-shot	Baselines	0.0439	0.1168	0.0938	0.0527	0.0894
metadata-enhanced-e5-base-v2-zero-shot	Baselines	0.0276	0.0936	0.0861	0.0375	0.1021
metadata-enhanced-gte-base-zero-shot	Baselines	0.0285	0.0604	0.0614	0.0333	0.0940
simple-bert-base-uncased-zero-shot	Baselines	0.0074	0.0352	0.0294	0.0100	0.0374
metadata-enhanced-bge-large-en-zero-shot	Baselines	0.0101	0.0323	0.0287	0.0108	0.0314
simple-contriever-base-zero-shot	Baselines	0.0049	0.0159	0.0159	0.0062	0.0372
metadata-enhanced-e5-small-v2-zero-shot	Baselines	0.0102	0.0142	0.0116	0.0090	0.0126
simple-e5-small-zero-shot	Baselines	0.0071	0.0113	0.0098	0.0089	0.0130
metadata-enhanced-contriever-base-msmarco	Baselines	0.0022	0.0081	0.0108	0.0026	0.0332
metadata-enhanced-trec-product-search-bge-large-en	Baselines	0.0000	0.0021	0.0008	0.0000	0.0000
simple-trec-product-search-gte-large	Baselines	0.0000	0.0015	0.0007	0.0001	0.0001
metadata-enhanced-trec-product-search-e5-large-v2	Baselines	0.0000	0.0015	0.0007	0.0000	0.0000
metadata-enhanced-trec-product-search-gte-large	Baselines	0.0000	0.0011	0.0006	0.0000	0.0000

results on the impact of using metadata vs simple data across some baseline runs. Based on this data, we note that when focused on NDCG@10, the introduction of metadata is somewhat of a mixed message. Some models see benefit from the additional information, and others see losses.

Despite this variability, our impact tends to be relatively small, as good retrievers models know an effect of less than 5%. When focused on recall, the message changes, as most models see an improvement in recall by using metadata.

Query	Max-Mean Gap	Systems Score 0
Elite (Elite) Volano/drivo/Kura For Body 329770001	0.9781	96.77%
small measuring rice bin Asvel	0.8037	70.97%
Switch protective film Japanese glass blue light reduction water repellent anti-fingerprint	0.7968	77.42%
Elegant satin floral lace ribbon lingerie set	0.7264	59.68%
onlypuff Pocket Shirts for Women Casual	0.6750	27.42%
Ekouaer Long Nightgown,Women's Loungewear Short Sleeve	0.6590	33.87%
Lugz Women's Empire Hi Wvt Fashion Boot	0.6559	24.19%
Dinosaur Pee Pee Teepee Wee	0.6553	41.94%
10th birthday decorations for girl	0.6548	19.35%
juDanzy kids knee high tube socks with grips	0.6461	58.06%
Matching Delivery Robe and Swaddle Blanket	0.6429	41.94%
UCGOU Bubble Mailers 7.25x12 Inch Teal 25 Pack	0.6277	24.19%
Cicy Bell Women's Sunflower	0.6211	62.90%
Canomo Lamp Light Kit Make a	0.6209	19.35%
5L matte black rectangular trash can with soft close lid and anti-bag slip liner for bathroom or kitchen	0.6206	50.00%
Women's UPF 50+ cotton linen bucket sun hat beige small	0.6163	24.19%
Small breed wet dog food Hill's Science Diet Chicken & Barley Recipe	0.6038	40.32%
DKB Evian Jetted Whirlpool	0.6031	27.42%
OtterBox Symmetry Disney Princess Mulan iPhone Xs iPhone X case	0.6002	45.16%
Stars in the Desert book	0.5958	58.06%
DC Collectibles Batman Arkham Origins	0.5930	35.48%
fall sunflower pumpkin placemats set of 6 cotton linen washable table mats	0.5853	27.42%
300 piece jigsaw puzzle Kitchen Memories by Steve Crisp	0.5821	30.65%
Marvel Avengers Endgame Gauntlet T-Shirt	0.5816	20.97%
Pahajim Women Fashion Purses Handbags Shoulder Tote Bags Top Handle Satchel	0.5811	46.77%
Mai Puru Endo Mai's First Photo Collection	0.5806	66.13%
girls princess dress up costume headband accessories	0.5764	19.35%
Nanatang Badflower Logo Men's Long Sleeve Sweatshirt's	0.5756	14.52%
HAPY SHOP 80 Pcs Silver Alligator Hair	0.5705	45.16%
VERYKE L-Shaped sectional sofa chenille fabric golden legs living room	0.5689	27.42%
ZINUS Owen Wood Platform	0.5667	29.03%
Xperia 10 II Blue Light Cut Glass Film Asahi Japanese Ultra Thin Anti-Bubble Anti-Fingerprint	0.5630	67.74%
Acer V6 V196LB 19" HD	0.5619	50.00%

Table 4: Per query gap between Mean NDCG@10 and Max NDCG and the % of retrieval systems with a NDCG@10 of zero.

Run	Zero Shot	NDCG @10 (metadata)	NDCG @10 (simple)	Impact
BM25	Y	0.6408	0.6540	-0.0133
all-MiniLM-L12-v2	Y	0.5660	0.5288	0.0371
all-MiniLM-L6-v2	Y	0.5328	0.4952	0.0376
all-mpnet-base-v2	Y	0.5937	0.5895	0.0043
bge-base-en	Y	0.3396	0.2948	0.0448
bge-large-en	Y	0.0323	0.1486	-0.1163
contriever-base	Y	0.0081	0.0159	-0.0079
e5-base-v2	Y	0.0936	0.1168	-0.0232
e5-small-v2	Y	0.0142	0.0113	0.0029
gte-base	Y	0.0604	0.1493	-0.0889
gte-large	Y	0.4501	0.3930	0.0571
gte-small	Y	0.6647	0.6612	0.0035
bge-base-en	N	0.4237	0.4064	0.0174
bge-small-en	N	0.4721	0.4379	0.0342
Bert-base	N	0.4165	0.4272	-0.0107
gte-base	N	0.5009	0.4777	0.0233
gte-large	N	0.0011	0.0015	-0.0005
gte-small	N	0.5168	0.4901	0.0267
all-miniLM-L12-v2	N	0.4681	0.4763	-0.0082
all-miniLM-L6-v2	N	0.4673	0.4591	0.0082
all-mpnet-base-v2	N	0.4089	0.4090	-0.0001

Table 5: NDCG@10 performance of retrieval methods using the simple collection and metadata enhanced collection.

However, like the impact on the top ten, recall improvements are minor, with a few exceptions. Across both metrics, we do not see any impact trend related to fine-tuned or zero-shot models.

Finetune *vs.* Zero-Shot As part of our baselines, we evaluated a set of naive baselines where we finetune in a single form and compare the impact of fine-tuning across runs. We leverage the Tevatron library and follow the training

Run	Zero Shot	R@100 (Metadata)	R@100 (Simple)	Impact
BM25	Y	0.7272	0.7241	0.0032
all-MiniLM-L12-v2	Y	0.6558	0.6365	0.0193
all-MiniLM-L6-v2	Y	0.6415	0.6099	0.0316
all-mpnet-base-v2	Y	0.6512	0.6348	0.0163
bge-base-en	Y	0.4301	0.2664	0.1637
bge-large-en	Y	0.0314	0.0787	-0.0473
contriever-base	Y	0.0332	0.0372	-0.0040
e5-base-v2	Y	0.1021	0.0894	0.0127
e5-small-v2	Y	0.0126	0.0130	-0.0005
gte-base	Y	0.0940	0.0965	-0.0026
gte-large	Y	0.4978	0.4294	0.0684
gte-small	Y	0.7416	0.7372	0.0044
bge-base-en	N	0.4955	0.4728	0.0227
bge-small-en	N	0.5565	0.5080	0.0485
Bert-base	N	0.5208	0.5068	0.0140
gte-base	N	0.5895	0.5676	0.0219
gte-large	N	0.0000	0.0001	-0.0001
gte-small	N	0.5859	0.5692	0.0167
all-miniLM-L12-v2	N	0.5581	0.5351	0.0230
all-miniLM-L6-v2	N	0.5528	0.5429	0.0099
all-mpnet-base-v2	N	0.5006	0.4747	0.0259

Table 6: Recall@100 performance of retrieval methods using the simple collection and metadata enhanced collection.

procedure from the NQ implementation [2]. We train each model for 40 epochs using 4 A100 with a batch size of 128, cross-device negatives, and learning rates of 1e-5,2e-5,3e-5,5e-5, and 1e-4, selecting the model that had the lowest validation loss at the end. These runs are not meant to be highly optimized fine-tuning runs but general explorations on the impact of fine-tuning. As shown in tables 9 and 10, we see a consistent trend that the larger models suffer from fine-tuning (indicating the fine-tuning recipe was incorrect), but smaller models see large gains, in some cases going from completely unusable to highly competitive.

5 Conclusion

This is the first year of the TREC Product Search Track. In our first year, we aimed to create a complete collection that could reliably evaluate the performance of different retrieval methods in the product search domain. In creating this initial collection, we introduce forms of collection enrichment via product images and metadata. Using this collection, we create a large set of artificial queries using a large language model and evaluate system performance using pooled judgment via query-product relevant judgments.

While this year's participation was light, we believe that the strong fundamentals of this collection pave the way to broader experimentation. This report summarizes the product search track's creation, the systems' high-level performance, and the perceived impact of additional metadata.

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A Per Query Performance

B Impact of Finetuning on single stage Language Model Based Retrieval

C Stratifying based on query length

Query	Max	Mean	Gap Max vs Mean	Systems with NDCG@10 = 0
Elite (Elite) Volano/drivo/Kura For Body 329770001	1.0000	0.0219	0.9781	96.77%
small measuring rice bin Asvel	1.0000	0.1963	0.8037	70.97%
Switch protective film Japanese glass blue light reduction water repellent anti-fingerprint	0.9056	0.1088	0.7968	77.42%
Elegant satin floral lace ribbon lingerie set	0.8122	0.0858	0.7264	59.68%
onlypuff Pocket Shirts for Women Casual	1.0000	0.3250	0.6750	27.42%
Ekouaer Long Nightgown,Women's Loungewear Short Sleeve	0.8415	0.1825	0.6590	33.87%
Lugz Women's Empire Hi Wvt Fashion Boot	1.0000	0.3441	0.6559	24.19%
Dinosaur Pee Pee Teepee Wee	1.0000	0.3447	0.6553	41.94%
10th birthday decorations for girl	0.9558	0.3010	0.6548	19.35%
juDanzy kids knee high tube socks with grips	1.0000	0.3539	0.6461	58.06%
Matching Delivery Robe and Swaddle Blanket	1.0000	0.3571	0.6429	41.94%
UCGOU Bubble Mailers 7.25x12 Inch Teal 25 Pack	0.9117	0.2840	0.6277	24.19%
Cicy Bell Women's Sunflower	0.8891	0.2680	0.6211	62.90%
Canomo Lamp Light Kit Make a	0.9157	0.2948	0.6209	19.35%
5L matte black rectangular trash can with soft close lid and anti-bag slip liner for bathroom or kitchen	0.8923	0.2717	0.6206	50.00%
Women's UPF 50+ cotton linen bucket sun hat beige small	1.0000	0.3837	0.6163	24.19%
Small breed wet dog food Hill's Science Diet Chicken & Barley Recipe	0.9904	0.3866	0.6038	40.32%
DKB Evian Jetted Whirlpool	0.9083	0.3052	0.6031	27.42%
OtterBox Symmetry Disney Princess Mulan iPhone Xs iPhone X case	0.9242	0.3240	0.6002	45.16%
Stars in the Desert book	1.0000	0.4042	0.5958	58.06%
DC Collectibles Batman Arkham Origins	0.9369	0.3439	0.5930	35.48%
fall sunflower pumpkin placemats set of 6 cotton linen washable table mats	0.9813	0.3960	0.5853	27.42%
300 piece jigsaw puzzle Kitchen Memories by Steve Crisp	1.0000	0.4179	0.5821	30.65%
Marvel Avengers Endgame Gauntlet T-Shirt	0.9842	0.4026	0.5816	20.97%
Pahajim Women Fashion Purses Handbags Shoulder Tote Bags Top Handle Satchel	1.0000	0.4189	0.5811	46.77%
Mai Puru Endo Mai's First Photo Collection	0.6353	0.0547	0.5806	66.13%
girls princess dress up costume headband accessories	0.8645	0.2881	0.5764	19.35%
Nanatang Badflower Logo Men's Long Sleeve Sweatshirt's	0.9375	0.3619	0.5756	14.52%
HAPY SHOP 80 Pcs Silver Alligator Hair	0.8525	0.2820	0.5705	45.16%
VERYKE L-Shaped sectional sofa chenille fabric golden legs living room	0.9095	0.3406	0.5689	27.42%
ZINUS Owen Wood Platform	1.0000	0.4333	0.5667	29.03%
Xperia 10 II Blue Light Cut Glass Film Asahi Japanese Ultra Thin Anti-Bubble Anti-Fingerprint	0.6367	0.0737	0.5630	67.74%
Acer V6 V196LB 19" HD	0.6797	0.1178	0.5619	50.00%
eyebrow tattoo stickers natural black dark brown	0.5980	0.0393	0.5587	80.65%
buffalo plaid flannel pajama pants for women with pockets	0.7937	0.2350	0.5587	35.48%
Women's Hotouch fringe vest faux suede 70s hippie sleeveless cardigan	1.0000	0.4460	0.5540	35.48%
Microsoft Surface Laptop 2	0.9698	0.4175	0.5523	25.81%
men's sauna suit diet pants sportswear fat burner fitness wear exercise running weight loss black	0.6477	0.0972	0.5505	59.68%
Fabri.YWL 1955 Ford Thunderbird Vintage Look Reproduction	0.9639	0.4182	0.5457	37.10%
Figma Avengers Age of Ultron Iron Man Mark 43 Exclusive	0.8974	0.3579	0.5395	20.97%
Under Armour Men's Jungle Rat Tactical	0.9614	0.4224	0.5390	24.19%
Black Cast Iron Norfolk Door Latch 8" Tall Thumb Lock with Mounting Hardware	0.9056	0.3707	0.5349	35.48%
CRAFTSMAN CMXZVBE38759 2-1/2 in. x 20 ft. POS-I-LOCK	0.7560	0.2226	0.5334	58.06%
Columbia Women's Newton Ridge Waterproof Hiking Boot lightweight comfortable	0.9567	0.4238	0.5329	17.74%
KATUMO Baby Crib Mobile Woodland Hot Air Balloons Birds Clouds Nursery Decoration	1.0000	0.4707	0.5293	22.58%
Spider-Man Miles Morales Venom 3 Pack T-Shirts for kids	0.7881	0.2589	0.5292	53.23%
double zipper smart key case genuine leather	0.8514	0.3239	0.5275	14.52%
Alex Evenings womens Plus Size Midi Scoop Neck Shift	0.8538	0.3269	0.5269	33.87%
cotton candy party kit 100 cones five flavors	0.8898	0.3647	0.5251	25.81%
black wood electric guitar ornament	1.0000	0.4852	0.5148	24.19%
Motorola Moto E6 Play 5.5" pantalla, 2GB RAM, 32GB almacenamiento, Android 9.0, Dual SIM, Gris	0.9307	0.4170	0.5137	20.97%
Harley-Davidson Enjoy Ride Oval Embossed Tin Sign, 18	1.0000	0.4875	0.5125	24.19%
Quiksilver Men's Long Sleeve Rashguard UPF 50 Sun Protection Surf Shirt	0.8611	0.3492	0.5119	16.13%
Eternal Nail Polish Set (BEACH WALK)	0.9788	0.4681	0.5107	20.97%
CINRA 20PCS Disposable Tattoo Tubes Grips Mixed Sizes	0.8786	0.3683	0.5103	27.42%
Dotty the Dalmatian plush mascot costume men's	1.0000	0.4950	0.5050	29.03%
Levi's Women's High Waisted Mom Shorts	1.0000	0.4954	0.5046	14.52%
HDMI to VGA DVI HDMI adapter 4 in 1 video converter for laptop monitor projector	0.7962	0.2922	0.5040	32.26%
Nike Dri-Fit Men's Half Zip Golf Top	0.8553	0.3514	0.5039	17.74%
MixMatchy Women's Striped Print Ribbed Knit Crop	1.0000	0.4976	0.5024	12.90%
Dr. Martens Women's Shriver Hi Fashion Boot chunky sole	0.8888	0.3906	0.4982	25.81%
Thankful Deluxe Fall Party Dinnerware Bundle with Dinner Plates, Dessert Plates, and Large Napkins	0.9658	0.4710	0.4948	19.35%
Summer Clean Rinse Baby Bather (Gray)	0.9713	0.4771	0.4942	25.81%
large black hair claw clips for thick hair women girls	0.7120	0.2186	0.4934	27.42%
green camouflage RFID trifold canvas wallet for men with mini coin purse and front pocket for kids	0.8033	0.3148	0.4885	32.26%
Find RAINBEAN foldable laptop table for bed with storage space and bamboo wood grain	0.9647	0.4786	0.4861	19.35%
short black cosplay wig for men	0.8409	0.3579	0.4830	20.97%
Detroit Axle - 4WD 8-Lug Front Wheel	0.8406	0.3578	0.4828	24.19%
Apple Lime Green Deco Mesh Ribbon 10 inch for Christmas Wreath and Spring Decorations	0.9260	0.4444	0.4816	24.19%
RJ-Sport No-Tie, Elastic Shoelaces,	1.0000	0.5212	0.4788	22.58%
hypoallergenic baby bottle dishwashing liquid fragrance free	0.9267	0.4495	0.4772	24.19%
AUGYMER stainless steel serrated bread knife 7.9 inches	1.0000	0.5245	0.4755	20.97%
Kaenon Men's Polarized Sunglasses Burnet Full Coverage Matte Tortoise	1.0000	0.5278	0.4722	20.97%
2-pack aluminum no firearms guns or weapons allowed sign 10x7 waterproof	0.9922	0.5203	0.4719	25.81%
LED Candles, Ymenow Warm	0.6399	0.1688	0.4711	37.10%
Ralph Lauren Meadow Lane Kaley King Comforter Blue Multi	0.9902	0.5192	0.4710	19.35%
Portable RGB Gaming Mechanical Keyboard USB Type	0.8618	0.3913	0.4705	17.74%
Coppertone Defend & Care Sensitive Skin Sunscreen Lotion Broad	0.8670	0.4012	0.4658	24.19%
Nike Kids' Grade School Zoom Air Pegasus	0.9933	0.5282	0.4651	27.42%
Blue rectangular plastic tablecloth 54x108 inch for parties and outdoor	0.9292	0.4659	0.4633	14.52%
Talking Products, Talking Tile	0.6971	0.2342	0.4629	51.61%
Double sided rug tape for laminate flooring 2 inch 30 yards	0.9273	0.4690	0.4583	19.35%
Nordic Ware Platinum Collection Anniversary Bundtlette	0.8968	0.4404	0.4564	30.65%
glass essential oil diffuser ultrasonic aromatherapy humidifier wood natural	0.9373	0.4842	0.4531	20.97%
purple ergonomic document copy holder with side arm	0.8840	0.4311	0.4529	25.81%
iPhone 6 Plus replacement touch screen LCD panel with repair tools	0.7864	0.3340	0.4524	17.74%
TRUE LINE Automotive Universal 7 Inch	0.4998	0.0486	0.4512	77.42%
Kiss Tweetheart False Nails with accents and super hold adhesive	1.0000	0.5496	0.4504	19.35%
Mayton wooden bunkie board slats Twin XL Beige	1.0000	0.5506	0.4494	29.03%
16 oz clear plastic cups with flat lids set of 50	0.9556	0.5091	0.4465	11.29%
Benefit Boi ing Hydrating Concealer Light Medium	1.0000	0.5560	0.4440	27.42%
Google Wi-Fi System Mesh	1.0000	0.5565	0.4435	16.13%
YONEX AC1025P Tennis Badminton Grip	0.4920	0.0488	0.4432	70.97%
ASICS Women's Gel-Venture 7 trail running shoes	1.0000	0.5592	0.4408	32.26%
Blushing Cherry Blossom Fragrance Oil (60ml) For	0.8977	0.4585	0.4392	19.35%
Ateco Pastry Leaf Tube Set White	1.0000	0.5610	0.4390	24.19%
Garmin ECHOMAP Plus 73cv Ice	0.9540	0.5151	0.4390	24.19%
7x5ft Black and Gold Balloons Backdrop for Birthday Party Photography	0.7982	0.3599	0.4383	22.58%
5 Pcs Colorful Mini Silicone Whisks Stainless Steel Non Stick for Cooking Baking	0.9337	0.4956	0.4381	17.74%
Custom Self Inking Rubber Stamp 4 Lines Extra Ink Pad A1848	0.8462	0.4123	0.4339	20.97%
Organic baby toddler short sleeve tight fit pajamas Lamaze	0.7029	0.2693	0.4336	29.03%

Table 7: Per Query Mean NDCG Scores and Variability on first 100 queries. For each query, we measure using NDCG@10 the min, mean, gap between mean and max, and the percentage of systems that have an NDCG@10 of 0, denoting a completely irrelevant retrieval set

Query	Max	Mean	Gap Max vs Mean	Systems with NDCG@10 = 0
Microsoft Surface Pro Signature Type Cover Platinum FFP-00141 for Surface Pro 7	0.9721	0.5385	0.4336	17.74%
Kids sandwich cutter and sealer set with star, heart, and circle shapes for lunchbox and bento box	0.9181	0.4863	0.4318	22.58%
ergonomic stool adjustable height footrest ring parquet wheels	0.6176	0.1858	0.4318	24.19%
Onvian Bike Alarm with Remote, Wireless	1.0000	0.5709	0.4291	22.58%
acrylic lollipop holder cake pop stand with sticks, bags, and twist ties	0.8547	0.4272	0.4275	16.13%
90 degree right angled Micro USB 2.0 Male to Female extension cable 50cm for tablet phone	0.9359	0.5108	0.4251	14.52%
Goodman 4 Ton 14	0.7710	0.3463	0.4247	24.19%
OTTERBOX COMMUTER SERIES iPhone 11 Pro case with PopSockets PopGrip	0.8303	0.4067	0.4236	29.03%
Probrico flat black cabinet pulls 3 inch hole centers T bar handle kitchen dresser 10 pack	0.8018	0.3829	0.4190	22.58%
Madagascar Bourbon Planifolia Grade A Vanilla Beans 5-6 inches	0.8182	0.4013	0.4169	27.42%
Nerf Mega Accustrike Dart Refill Combat Blaster	0.8542	0.4395	0.4147	17.74%
100% Cotton Throw Blanket for Couch Sofa Bed Outdoors Hypoallergenic 83"x70" Brown	0.8888	0.4753	0.4135	8.06%
Zoostliss Crimping Tool for Coaxial Cable RG6 RG59 with Blue F Connector	0.9872	0.5770	0.4102	17.74%
adidas ladies climalite short-sleeve polo	0.8080	0.3980	0.4100	16.13%
Hofdeco nautical indoor outdoor pillow cover navy blue compass anchor 12x20 set of 2	0.8266	0.4170	0.4096	20.97%
Hurley Men’s Printed Backpack Light Carbon	0.9072	0.4995	0.4077	27.42%
Giorgio Armani Code Colonia men’s Eau de Toilette Spray 2.5 oz	0.9571	0.5504	0.4067	20.97%
Extra Large Moist Heating Pad	1.0000	0.5952	0.4048	20.97%
HOBO Vintage Euro Slide Credit Card Holder Wallet	0.7783	0.3753	0.4030	20.97%
Gueray Portable CD Player,	0.9758	0.5729	0.4029	16.13%
HDMI to RCA converter for TV, Roku, Fire Stick, DVD, Blu-ray player	1.0000	0.5973	0.4027	12.90%
Ombre highlight short bob human hair wig brown to blonde Brazilian straight remy for black women	0.9140	0.5142	0.3998	12.90%
Muga Black Felt Letter Board 12x12 inch with 485 Precut Letters and Stand	0.7829	0.3846	0.3983	19.35%
Deflecto 5-bin horizontal tilt bin storage system black	0.9789	0.5811	0.3978	17.74%
Iridescent Metal Lighter Case for BIC Lighters, Lighter	0.9098	0.5131	0.3967	20.97%
Jill & Joey Maternity Belt Belly Band Medium Beige Pregnancy Support	0.8930	0.4980	0.3950	20.97%
Calvin Klein Women’s Invisibles Hipster Panty	1.0000	0.6086	0.3914	19.35%
KOKUYO Campus Notebook B5 Dotted A-Ruled 5-Colors 6 Pack	0.9047	0.5154	0.3893	24.19%
magnetic dart board for kids boys girls gifts	1.0000	0.6108	0.3892	22.58%
Rokinon Cine DS Lens Kit Micro Four Thirds 16mm 35mm 50mm 85mm	0.9597	0.5726	0.3871	22.58%
Zealer 1800pcs Crystals AB Nail Art Rhinestones Flatback Glass Charms for Nails Decoration Eye Makeup Clothes Shoes Mix Sizes	0.7793	0.3936	0.3857	24.19%
Perricone MD Neuropeptide Facial Conformer	0.8735	0.4879	0.3856	22.58%
Soda Pop Can Covers Made in USA BPA-Free Retains Fizz	0.9023	0.5233	0.3790	17.74%
Baby Toddler Girls Long Sleeve	1.0000	0.6216	0.3784	9.68%
Blue pet grooming gloves for hair removal and massage	0.9742	0.5976	0.3766	19.35%
AnnTec LED Candle Light, LED Glass,	0.4367	0.0602	0.3765	67.74%
Osprey Daylite Shoulder Sling for daily essentials and quick hikes	0.8261	0.4508	0.3753	12.90%
Tminnov Baby Diaper Caddy	0.8567	0.4832	0.3735	12.90%
NFL Women’s OTS Fleece Hoodie	0.9003	0.5308	0.3695	17.74%
39 watt halogen PAR20 clear medium base bulb	0.7402	0.3713	0.3689	17.74%
Daiwa Liberty Club Short Swing	0.3904	0.0224	0.3680	91.94%
4 ton hydraulic low profile floor jack with dual piston quick lift pump	0.9062	0.5384	0.3678	20.97%
universal knife and tool sharpener with adjustable angle guides	0.6768	0.3095	0.3673	22.58%
OTC 4842 Heavy Duty Valve Spring Compressor	1.0000	0.6335	0.3665	19.35%
Spencer 50’/15M Logger Tape Refill	0.9121	0.5463	0.3658	19.35%
Toozey Dog Pooper Scooper, Upgraded Adjustable Long	1.0000	0.6383	0.3617	16.13%
Lovelyshop Blue Gems Rhinestone	0.4991	0.1385	0.3606	22.58%
sparkly rhinestone mesh face mask for women masquerade party glitter bling Christmas	0.9120	0.5517	0.3603	12.90%
Enameled Cast Iron Dutch Oven 6.5 quart Olive Green	0.9013	0.5429	0.3584	16.13%
Huffy 12V Battery Powered Ride On ATV for kids aged 2-5	0.7172	0.3600	0.3572	24.19%
artificial eucalyptus plant for wedding jungle theme party home decor	1.0000	0.6433	0.3567	19.35%
Klein Tools Mini Tube Cutter for copper and aluminum tubing	0.7522	0.3980	0.3542	25.81%
An Untamed Heart Red River of the North book	1.0000	0.6463	0.3537	24.19%
New American citizen mug US flag coffee cup gift	0.9053	0.5531	0.3522	12.90%
Ernie Ball Custom Gauge 11 Nickel Guitar String 6 Pack	0.8578	0.5087	0.3491	24.19%
Bobbi Brown Lip Color Rum Raisin 3.4g	1.0000	0.6513	0.3487	19.35%
21x21 beige sun shade sail patio UV protection outdoor backyard	0.7790	0.4350	0.3440	12.90%
Carhartt Men’s Heavyweight Short-Sleeve Pocket T-Shirt	1.0000	0.6572	0.3428	16.13%
Hokkaido Deer Lotion CICA Ceramide Vitamin C 5.1 fl oz	0.4177	0.0752	0.3425	56.45%
Rise Pea Protein Bar,	0.9030	0.5638	0.3393	19.35%
Hunter Watson Indoor ceiling fan with LED light and pull chain control, New Bronze finish	0.9504	0.6115	0.3389	16.13%
Belkin QODE Ultimate Pro Keyboard Case for iPad Air 2 White	0.9291	0.5909	0.3382	17.74%
The Fifth Agreement book self-mastery Toltec Wisdom	0.9427	0.6060	0.3367	14.52%
Echo Dot Wall Mount Holder Black AhaStyle	0.9878	0.6540	0.3338	4.84%
Soft Spiked Light Up Bracelets with Flashing Blinking LED Lights	0.7561	0.4228	0.3333	14.52%
migraine relief hat hot cold therapy reusable MarkGifts	0.9336	0.6005	0.3331	20.97%
cordless portable blender rechargeable battery smoothie mixer travel	1.0000	0.6693	0.3307	19.35%
LYXOTO Baby Hair Clips set of 10 bow knot cute stylish birthday gift	0.7265	0.3989	0.3276	11.29%
Plaskidy plastic forks for kids set of 16 BPA free dishwasher safe	0.7287	0.4106	0.3181	12.90%
Nantucket Neighbors (Nantucket Beach Plum Cove Book 2)	1.0000	0.6838	0.3162	16.13%
Physicians Formula Highlighter Makeup Powder Mineral Glow Pearls, Light Bronze	0.9623	0.6466	0.3157	20.97%
Organic Kabuli Chana 4 lb White	0.7598	0.4503	0.3095	20.97%
PEARL IZUMI Elite Thermal Arm Warmer for cool weather cycling with water-shedding fleece and unisex sizing	0.9928	0.6874	0.3054	19.35%
GE 6-Device Backlit Universal Remote Control for Samsung, Vizio, LG, Sony, Sharp, Roku, Apple TV, Blu-Ray, DVD, Master Volume Control, Rose Gold	1.0000	0.6963	0.3037	19.35%
SPLOTY Tire Inflator Air Compressor Portable 12V	1.0000	0.6979	0.3021	19.35%
VAKA Luminous Light Up Quad Roller Skate	0.6643	0.3624	0.3019	19.35%
Black+Decker 5-Cup Coffeemaker Dust Proof Cover	0.6907	0.3924	0.2983	20.97%
Celestial Seasonings Honey Vanilla Chamomile Herbal Tea 20 Count	0.9059	0.6086	0.2973	17.74%
large washable donut dog bed with calming cuddler and head support	0.8315	0.5356	0.2959	12.90%
professional hair cutting scissors extremely sharp blades 6 inch barber scissors set for men and women Fagaci	0.7568	0.4615	0.2953	17.74%
Stoplight Sleep Enhancing Alarm Clock for Kids Train Car Clock	0.7001	0.4072	0.2929	17.74%
McCormick Coconut Extract 2 fl oz gluten-free non-GMO	0.6143	0.3433	0.2710	19.35%
XR Extinction Rebellion Rebel For Life T-Shirt	0.9449	0.6863	0.2586	11.29%
Dogfish 500GB Msata Internal SSD	0.2658	0.0126	0.2532	91.94%
Car glass coating agent with shampoo conditioner and water repellent for glossy finish	0.2038	0.0398	0.1640	53.23%

Table 8: Per Query Mean NDCG Scores and Variability on remaining 82 queries. For each query, we measure using NDCG@10 the min, mean, gap between mean and max, and the percentage of systems that have an NDCG@10 of 0, denoting a completely irrelevant retrieval set

Run	Collection Type	Zero Shot	Fine-tune	Impact
all-MiniLM-L12-v2	Simple	0.4952	0.4763	-0.0189
all-MiniLM-L12-v2	Metadata	0.5328	0.4681	-0.0647
all-miniLM-L6-v2	Simple	0.5895	0.4591	-0.1303
all-miniLM-L6-v2	Metadata	0.5937	0.4673	-0.1264
all-mpnet-base-v2	Simple	0.5895	0.4090	-0.1804
all-mpnet-base-v2	Metadata	0.5937	0.4089	-0.1848
bge-base-en	Simple	0.2948	0.4064	0.1116
bge-base-en	Metadata	0.3396	0.4237	0.0841
bge-large-en	Metadata	0.0323	0.0021	-0.0302
bge-small-en	Simple	0.3680	0.4379	0.0699
e5-large-v2	Simple	0.4998	0.0015	-0.4983
e5-base-v2	Metadata	0.0936	0.4242	0.3306
e5-small-v2	Metadata	0.0142	0.5119	0.4977
gte-base	Simple	0.1493	0.4777	0.3284
gte-base	Metadata	0.0604	0.5009	0.4405
gte-large	Simple	0.3930	0.0015	-0.3915
gte-large	Metadata	0.4501	0.0011	-0.4490
gte-small	Simple	0.6612	0.4901	-0.1711
gte-small	Metadata	0.6647	0.5168	-0.1479
bert-base	Metadata	0.4165	0.0352	-0.3813

Table 9: Impact on NDCG@10 of fine-tuning across baseline runs.

Run	Collection Type	Zero Shot	Fine-tune	Impact
all-MiniLM-L12-v2	Simple	0.6099	0.5351	-0.0747
all-MiniLM-L12-v2	Metadata	0.6415	0.5581	-0.0833
all-miniLM-L6-v2	Simple	0.6348	0.5429	-0.0920
all-miniLM-L6-v2	Metadata	0.6512	0.5528	-0.0984
all-mpnet-base-v2	Simple	0.6348	0.4747	-0.1602
all-mpnet-base-v2	Metadata	0.6512	0.5006	-0.1506
bge-base-en	Simple	0.2664	0.4728	0.2064
bge-base-en	Metadata	0.4301	0.4955	0.0654
bge-large-en	Metadata	0.0314	0.0000	-0.0314
bge-small-en	Simple	0.4188	0.5080	0.0893
e5-large-v2	Simple	0.5537	0.0000	-0.5537
e5-base-v2	Metadata	0.1021	0.5148	0.4127
e5-small-v2	Metadata	0.0126	0.6096	0.5970
gte-base	Simple	0.0965	0.5676	0.4711
gte-base	Metadata	0.0940	0.5895	0.4956
gte-large	Simple	0.4294	0.0001	-0.4293
gte-large	Metadata	0.4978	0.0000	-0.4978
gte-small	Simple	0.7372	0.5692	-0.1679
gte-small	Metadata	0.7416	0.5859	-0.1557
bert-base	Metadata	0.5208	0.0374	-0.4834

Table 10: Impact on Recall@100 of fine-tuning across baseline runs.

Run	NDCG @10 (All)	NDCG@10 (Short)	NDCG@10 (Long)
f_splade_bm25	0.7505	0.7407	0.7578
f_splade_clip_bm25	0.7327	0.7078	0.7511
cfdaclip_ER_B	0.7256	0.7119	0.7358
cfdaclip_MR_B	0.7251	0.7108	0.7357
cfdaclip_MR_A	0.7257	0.7122	0.7357
cfdaclip_ER_A	0.7252	0.7111	0.7356
JBNU-C	0.7251	0.7130	0.7341
JBNU-1	0.6531	0.6060	0.6878
simple-gte-small-zero-shot	0.6612	0.6253	0.6877
metadata-enhanced-gte-small-zero-shot	0.6647	0.6343	0.6872
JBNU-2	0.6583	0.6238	0.6838
BM25-pyserini-simple-collection	0.6540	0.6184	0.6803
BM25-pyserini-metadata-collection	0.6408	0.6043	0.6643
f_gpt_rerank	0.6225	0.6162	0.6273
JBNU-A	0.5989	0.5616	0.6265
metadata-enhanced-all-mpnet-base-v2-zero-shot	0.5937	0.5586	0.6197
JBNU-B	0.5763	0.5294	0.6110
metadata-enhanced-all-MiniLM-L12-v2-zero-shot	0.5660	0.5072	0.6093
r_gpt3d5_turbo	0.5950	0.5766	0.6087
simple-all-mpnet-base-v2-zero-shot	0.5895	0.5687	0.6048
simple-all-MiniLM-L12-v2-zero-shot	0.5288	0.4721	0.5707
metadata-enhanced-trec-product-search-gte-small	0.5168	0.4457	0.5693
metadata-enhanced-all-MiniLM-L6-v2-zero-shot	0.5328	0.4938	0.5616
simple-e5-large-zero-shot	0.4998	0.4230	0.5565
metadata-enhanced-trec-product-search-e5-small-v2	0.5119	0.4583	0.5514
metadata-enhanced-trec-product-search-gte-base	0.5009	0.4471	0.5407
simple-trec-product-search-gte-small	0.4901	0.4535	0.5171
metadata-enhanced-trec-product-search-bge-small-en	0.4721	0.4192	0.5112
simple-all-MiniLM-L6-v2-zero-shot	0.4952	0.4746	0.5104
metadata-trec-product-search-all-miniLM-L12-v2	0.4681	0.4193	0.5042
simple-trec-product-search-gte-base	0.4777	0.4430	0.5032
metadata-trec-product-search-all-miniLM-L6-v2	0.4673	0.4427	0.4856
simple-trec-product-search-all-miniLM-L12-v2	0.4763	0.4650	0.4847
simple-trec-product-search-all-miniLM-L6-v2	0.4591	0.4444	0.4700
metadata-enhanced-trec-product-search-e5-base-v2	0.4242	0.3698	0.4644
metadata-enhanced-gte-large-zero-shot	0.4501	0.4361	0.4604
metadata-enhanced-trec-product-search-bge-base-en	0.4237	0.3847	0.4525
simple-trec-product-search-bge-small-en	0.4379	0.4267	0.4462
search-dpr-bert-base	0.4272	0.4029	0.4452
metadata-enhanced-trec-product-search-dpr-bert	0.4165	0.3805	0.4430
metadata-trec-product-search-all-mpnet-base-v2	0.4089	0.3784	0.4315
simple-trec-product-search-all-mpnet-base-v2	0.4090	0.3851	0.4267
simple-trec-product-search-bge-base-en	0.4064	0.3932	0.4161
simple-gte-large-zero-shot	0.3930	0.3647	0.4140
simple-bge-small-zero-shot	0.3680	0.3378	0.3903
metadata-enhanced-bge-base-en-zero-shot	0.3396	0.2902	0.3761
simple-bge-base-zero-shot	0.2948	0.2923	0.2967
simple-gte-base-zero-shot	0.1493	0.1696	0.1342
simple-bge-large-zero-shot	0.1486	0.1805	0.1250
simple-e5-base-zero-shot	0.1168	0.1350	0.1033
metadata-enhanced-e5-base-v2-zero-shot	0.0936	0.1127	0.0795
metadata-enhanced-gte-base-zero-shot	0.0604	0.0580	0.0621
simple-bert-base-uncased-zero-shot	0.0352	0.0417	0.0305
simple-contriever-base-zero-shot	0.0159	0.0044	0.0244
metadata-enhanced-e5-small-v2-zero-shot	0.0142	0.0046	0.0212
metadata-enhanced-bge-large-en-zero-shot	0.0323	0.0495	0.0197
simple-e5-small-zero-shot	0.0113	0.0046	0.0163
metadata-enhanced-contriever-base-msmarco	0.0081	0.0032	0.0116
metadata-enhanced-trec-product-search-bge-large-en	0.0021	0.0024	0.0019
simple-trec-product-search-gte-large	0.0015	0.0022	0.0010
metadata-enhanced-trec-product-search-gte-large	0.0011	0.0011	0.0010
metadata-enhanced-trec-product-search-e5-large-v2	0.0015	0.0023	0.0009

Table 11: Mean NDCG@10 performance of systems with full sample of queries (182), short queries (81), and long queries (101) across various systems.