

Revisiting the Basics: How Round Robin Improved Search Relevancy

Haystack 2024

Joelle Robinson

Senior Software Engineer, Digital Insights



Introduction

Algorithm Implementation

Problem Statement

Solution Exploration

Results

Conclusion & Q/A

Introduction A little about me

About Me

Joelle Robinson Senior Software Engineer Search Squad

Joelle Robinson is a Senior Software Engineer at Moody's with three years of experience on the search team. She played a crucial role on many projects during her tenure at Moody's like facilitating the transition from Solr to AWS OpenSearch. Currently, Joelle is focused on optimizing search relevance for keyword and semantic search functionalities for Moodys.com.

Problem Analysis An Overview of Search at MDC

Searching on Moodys.co The Search Results Page

An Overview

Here is our search results page on MDC. It contains different types of records. Data is presented to the user in various tabs.

- → The "All" tab is a view of all the results for the given query ac multiple indexes
- → The other tabs only display a single type of result like organizations or reports
- → Each tab has its own OpenSearch search template

💵 Organizations 🔐 Deals & Programs 🖹 Reports 🗐 Topics 🛱 Events 😨 Analysts 🗔 Solutions & Services

293936 results for Bank

Reports

Bank of Baroda: Key facts and statistics - Q3 December 2023

A summary company profile, detailing BOB's business operations and financial highlights.

Report | Issuer Profile | 08 Apr 2024 | Moody's Investors Service

🖹 Reports

Amen Bank: Update following change in outlook to stable

Our credit view of Amen reflects its modest albeit improving loss absorption capacity and its high direct exposure to the government of Tunisia with a tight liquidity profile.

Report | Credit Opinion | 06 Apr 2024 | Moody's Investors Service

🖹 Reports

Arab Tunisian Bank: Update following change in outlook to stable

Our credit view of this issuer reflects its stable funding base and sound liquidity buffer, constrained by its weak capital buffers and profitability pressured by elevated asset risk.

Report | Credit Opinion | 05 Apr 2024 | Moody's Investors Service

Reports

Bank of Queensland Limited: Update following rating action

Our credit view of this issuer reflects its liquidity position, offset by its profitability under pressure due to a rising cost base and

MOODY'S

Searching on Moodys.com The Verticals



Organizations

- Displays records that \rightarrow represent companies and subsidiaries
- A user can quickly \rightarrow navigate to a company's page to see any and everything pertaining to that org



 \rightarrow

Reports

- Research published \rightarrow within Moody's
 - The content can range \rightarrow from sector analysis and company peer comparison to rating actions for an entity
 - Must balance recency and relevancy of the content



Deals & Programs

- Structured finance \rightarrow deals
 - Closing dates for deals are important so we must sort accordingly



Topics

Links to pages on high \rightarrow level issues or topics like Environmental, Social and Governance (ESG) and Banking



Events

Events that Moody's has available online and in person

Revisiting the Basics: How Round Robin Improved Search Relevancy

Searching on Moodys.com The Verticals



Analysts

 → Moody's analysts and their contact information



Solutions & Services

→ Various sites regarding products and services provided by Moody's

Searching on Moodys.com The Verticals



Organizations

- → Displays records that represent companies and subsidiaries
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Problem Analysis Pain Points

The Problem Creating Balance



Problem

Pain Points

- → Differences between the content served in our comprehensive "All" view and single verticals
- \rightarrow Several search algorithms to maintain
- → Conflicting boosts from multiple indexes in the "All" pill make it difficult to improve relevance

Comprehensive "All" View

- → Several different indexes are used here to render the results list
- → Uses a search algorithm to cater to the needs of all 7 record types

ndividual	"vertical"	View
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→ One single index with a separate search algorithm tailored to the specific index

()B Deals &	& Programs	Reports	Topics E	vents @ Analysts	Solutions & Serv	ices
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ssigns	definitiv	e ratings	to GM Finan	cial Consume	r Automobile F	Receivables Trust
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Reports

Reports
 Moody's Ratings
 2024-2 notes

All In Organizations

12248 results for Gn

GM Group Limite

Report | Rating Action

Drganizations

GM Financial Consumer Automobile Receivables Trust 2024-2: Pre-Sale – GM Financial's second retail issuance of the GMCAR shelf in 2024

Our credit view of the transaction, including our analysis of the assets and the securitization structure.

Q Search ratings, research, analysts, and more.

Report | Pre-Sale Report | 01 Apr 2024 | Moody's Investors Service

Reports

TTD Holding III GmbH: Update to credit analysis

Our credit view of this issuer reflects its track record of positive FCF, against its high financial leverage.

Report | Credit Opinion | 11 Apr 2024 | Moody's Investors Service

Q Search ratings, research, analysts, and

(Research Assistant

All	Organizations	B Deals & Programs	Reports	Topics
	Sector	▼ Re	gion	

599 results for Gm

General Motors Company

GM is one of the world's largest automotive manufacturers. GM design increasingly, software enabled services and subscriptions. The compar

Automotive | United States | GM

GM Corp. 1991-A1 Pass Through

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Problem Analysis Metrics

Implicit Judgements	Control
Query Count	5000
Expected Reciprocal Rank	0.607
Sum Discounted Cumulative Gain	139370.002
Mean Average Precision	0.561
Precision	0.114
Age in Days	361.567

Problem Analysis

Key Takeaways & Acceptance Criteria

Increase maintainability

- \rightarrow Reduce the amount of search templates that we maintain
- \rightarrow Focus on single record types to avoid dealing with intermingled "battling boosts"
- \rightarrow Create a merging strategy for the individual vertical result lists to make "All"

Provide consistent search results

→ Ensure that the order of records of a given type is consistent between the individual search verticals and the comprehensive view

Do not decrease relevancy score metrics for ERR or DCG

→ Our relevance metrics for the "All" tab are relatively low already. Ensure that the introduction of the new merging strategy doesn't decrease metric scores.

Solution Exploration

Solution Exploration

Three Candidate Strategies

- \rightarrow Standard Round Robin solution (RR)
- \rightarrow Round Robin in blocks of *n* (RR2)

 $\rightarrow \quad \mbox{Convert open search scores to posterior} \\ \mbox{values and merge on posterior values}$





Solution Exploration

The Framework

Rank Biased Overlap (RBO)

- → Compares the values within ranked lists and quantifies their similarity
- → This will be used to compare the current search results to our proposed merging strategies



Expected Reciprocal Rank (ERR)

- → Indicates whether the top results are relevant for a given query
- → This will be used to measure the quality of results from our proposed merging strategies

	RBO RR	RBO RR2	RBO Posteriors
Query Count	4009	4009	4009
mean	0.844	0.842	0.491
std	0.122	0.123	0.144
min	0.000	0.000	0.000
25%	0.788	0.787	0.411
50%	0.879	0.878	0.485
75%	0.930	0.927	0.574
max	1.000	1.000	1.000

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	RBO RR	RBO RR2	RBO Posteriors
Query Count	4009	4009	4009
mean	0.803	0.792	0.481
std	0.137	0.139	0.169
min	0.000	0.000	0.000
25%	0.726	0.714	0.378
50%	0.831	0.821	0.500
75%	0.901	0.890	0.599
max	1.000	1.000	1.000

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Expected Reciprocal Rank @ 10

	Global ERR	RR ERR
Query Count	4009	4009
mean	0.573	0.635
std	0.275	0.226
min	0.000	0.000
25%	0.414	0.608
50%	0.684	0.707
75%	0.766	0.774
max	0.915	0.953

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max	0.915	0.953

Solution Implementation

Standard Round Robin solution

 \rightarrow Round Robin in blocks of *n*

 \rightarrow Convert open search scores to posterior values and merge on posterior values



Solution Implementation The Algorithm

- \rightarrow Use OpenSearch's _msearch endpoint
- → _msearch allows multiple requests to be sent in a single search request
- \rightarrow The requests are sent in parallel, and all results are returned at once





Solution Implementation The Algorithm

Standard Round Robin solution



General Algorithm

- 1. Alternate between organizations and reports for the top ten
- 2. Complete the results list by performing traditional round robin on the other record types until we've filled our page limit







The New Search Results Page

MOODY'S

Q Search ratings, research, analysts, and more () Research Assistant	Q Search ratings, research, analysts, and more (> Research Assistant
All 🗄 Organizations 🔐 Deals & Programs 🖹 Reports 🗐 Topics 🛱 Events 🕲 Analysts 🗔 Solutions & Services	All 🗄 Organizations 🕼 Deals & Programs 🖹 Reports 🛱 Topics 🛱 Events 😨 Analysts 🖾 Solutions & Services Filters 🏹
10243 results for Gm	Sector Region CReset
Drganizations	
General Motors Company	599 results for Gm
GM is one of the world's largest automotive manufacturers. GM designs, builds, and sells trucks, crossovers, cars, automotive parts and, increasingly, software enabled services and subscriptions. The company markets its vehicles under the Buick, Cadillac, Chevrolet	General Motors Company
Organization Automotive United States GM	GM is one of the world's largest automotive manufacturers. GM designs, builds and sells trucks, crossovers, cars, automotive parts and, increasingly, software enabled services and subscriptions. The company markets its vehicles under the Buick, Cadillac, Chevrolet and
Reports	Automotive United States GM
GM Financial Consumer Automobile Receivables Trust 2024-2: Pre-Sale – GM Financial's second retail issuance of the GMCAR shelf in 2024	GM Corp. 1991-A1 Pass Through
Our credit view of the transaction, including our analysis of the assets and the securitization structure.	Automotive United States GM
Report Pre-Sale Report 01 Apr 2024 Moody's Investors Service	
	GM Corp. 1991-A2 Pass Through
Drganizations	Automotive United States GM
GM Corp. 1991-A1 Pass Through	
Organization Automotive United States GM	General Motors Corporation (Old)
Reports	Automotive United States GM
GM Financial Consumer Automobile Receivables Trust 2024-1: Pre-Sale – GM Financial's first retail issuance of the GMCAR shelf in 2024	GM Group Limited
Our credit view of the transaction, including our analysis of the assets and the securitization structure.	Retail & Business Products United Kingdom

The Results Wins



The Wins Consistency

Q Search ratings, research, analysts, and more (> Research Assistant	Q Search ratings, research, analysts, and more () Research Assistant
All 🗈 Organizations 🔠 Deals & Programs 🖻 Reports 📴 Topics 🛱 Events 🕲 Analysts 🗔 Solutions & Services	All 📴 Organizations 🖫 Deals & Programs 🖹 Reports 🗭 Topics 🛱 Events 🕲 Analysts 🖾 Solutions & Services Filters 🍸
10243 results for Gm	Sector Region CReset
Organizations General Motors Company	599 results for Gm
GM is one of the world's largest automotive manufacturers. GM designs, builds, and sells trucks, crossovers, cars, automotive parts and, increasingly, software enabled services and subscriptions. The company markets its vehicles under the Buick, Cadillac, Chevrolet	General Motors Company
Organization Automotive United States GM	GM is one of the world's largest automotive manufacturers. GM designs, builds and sells trucks, crossovers, cars, automotive parts and, increasingly, software enabled services and subscriptions. The company markets its vehicles under the Buick, Cadillac, Chevrolet and
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GM Financial Consumer Automobile Receivables Trust 2024-2: Pre-Sale – GM Financial's second retail issuance of the GMCAR shelf in 2024	GM Corp 1991-A1 Pass Through
Our credit view of the transaction, including our analysis of the assets and the securitization structure.	Automotive United States GM
Report Pre-Sale Report 01 Apr 2024 Moody's Investors Service	
面 Organizations GM Corp. 1991-A1 Pass Through	GM Corp. 1991-A2 Pass Through Automotive United States GM
Organization Automotive United States GM	General Motors Corporation (Old)
Reports	Automotive United States GM
GM Financial Consumer Automobile Receivables Trust 2024-1: Pre-Sale – GM Financial's first retail issuance of the GMCAR shelf in 2024	GM Group Limited
Our credit view of the transaction, including our analysis of the assets and the securitization structure.	Retail & Business Products United Kingdom

A Quick Overview

Implicit Judgements and Relevancy Metric Scores

- \rightarrow Our implicit judgement query set contains 5000 queries
- \rightarrow The queries were chosen from a 6-month timeframe in our query logs
- \rightarrow The queries were chosen using probability proportional sampling
- → A hierarchal Bayesian Model was used to generate the judgements from the user interactions within the query logs
- \rightarrow We currently track the following metrics:
 - Average Expected Reciprocal Rank
 - Sum Discounted Cumulative Gain
 - Mean Average Precision
 - Average Precision
 - Average Age in Days

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 - Average Expected Reciprocal Rank
 - Sum Discounted Cumulative Gain
 - Mean Average Precision
 - Average Precision
 - Average Age in Days used only on our reports data to track recency

Implicit Judgements	Control	RR
Query Count	5000	5000
Average Expected Reciprocal Rank	0.607	0.665
Sum Discounted Cumulative Gain	139370.002	173734.402
Mean Average Precision	0.561	0.628
Average Precision	0.114	0.140
Average Age in Days	361.567	490.302

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Testing for Significance

We ran a dependent, two-sided t-test against our control and the round robin algorithm for every relevancy metric that we captured

The Wins Metrics – Significance

Implicit Judgements	Control	RR
Query Count	5000	5000
Average Expected Reciprocal Rank	0.607	0.665
Sum Discounted Cumulative Gain	139370.002	173734.402
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* P < 0.01











The Results Challenges

The Results Challenges

- \rightarrow Custom pagination proved to be a tedious and tricky issue
- \rightarrow Had to align the Front End with new stateful design
- \rightarrow The code for pagination became bloated quickly

Conclusion

Conclusion

Acceptance Criteria

Increase maintainability



Provide consistent search results



Do not decrease relevancy score metrics for ERR or DCG

Bonus:

Increased relevancy metric scores



Thank you

Joelle Robinson Senior Software Engineer/Digital Insights

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Appendix



Dora the Explorer. Https://Images-Wixmp-Ed30a86b8c4ca887773594c2.Wixmp.Com/,

https://images-wixmp-ed30a86b8c4ca887773594c2.wixmp.com/f/0cd82ff4-fa94-4020-9a16-f41089efc593/ddy9ni2-12582af3-e887-4ff9-b755-6 9f13240fbd1.png/v1/fill/w_650,h_1230,strp/dora__dora_the_explorer__kicreate_by_kiofficialart_ddy9ni2-pre.png?token=eyJ0eXAiOiJKV1QiLC JhbGciOiJIUzI1NiJ9.eyJzdWliOiJ1cm46YXBwOjdlMGQxODg5ODIyNjQzNzNhNWYwZDQxNWVhMGQyNmUwliwiaXNzljoidXJuOmFwcDo3ZT BkMTg4OTgyMjY0MzczYTVmMGQ0MTVIYTBkMjZIMCIsIm9iail6W1t7ImhlaWdodCl6Ijw9MjQyMiIsInBhdGgiOiJcL2ZcLzBjZDgyZmY0LWZhOT QtNDAyMC05YTE2LWY0MTA4OWVmYzU5M1wvZGR5OW5pMi0xMjU4MmFmMy1IODg3LTRmZjktYjc1NS02OWYxMzI0MGZiZDEucG5nliwi d2lkdGgiOiI8PTEyODAifV1dLCJhdWQiOIsidXJuOnNIcnZpY2U6aW1hZ2Uub3BIcmF0aW9ucyJdfQ.M0r7r1e0UNIagdenqQ8RxCjfRIzxVaxy-h8S ew2U-Xs.

Kriegler, Rene. "Haystack US 2022-René Kriegler,OSC-Modelling Implicit User Feedback for Optimising e-Commerce Search." *YouTube*, Haystack, 1 June 2022, www.youtube.com/watch?v=wa88XShl7hs.

Monopoly Man. Pre00.Deviantart.Net, https://pre00.deviantart.net/14a2/th/pre/f/2014/106/7/a/fallout_monopoly_by_d3epsilonx2-d7eqd6r.jpg.

Scale. cdn.pixabay.com, https://cdn.pixabay.com/photo/2017/08/12/17/33/scale-2634795_960_720.jpg

Swiper. (n.d.). images.uncyc.org. https://images.uncyc.org/en/thumb/4/4d/Swiper.gif/150px-Swiper.gif

T-Test Results Metrics

	ERR	DCG	MAP	Р	Avg Age in Days
T statistic	-2.265780e+01	0.822552	-3.490900e+01	-2.125044e+01	-8.608620e+00
Р	2.819082e-108	0.410802	4.003236e-239	5.161461e-96	9.777466e-18