

# Application of a BigQuery-based scoring model in the search management context

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# Agenda

- Introduction
- Search Management & Search Quality
- Automatisatisation as challenge
- Requirements and goals
- The collaborative scoring model
- Search results, pros and cons
- What's next?

# Search Management

## Search Quality as a business goal

- Sessions with Search: around 30%
- Search Revenue Share: around 53%
- Search Conversion Multiplier: 2.6

⇒ These and other search related KPIs show positive YoY development (16/17 vs 17/18)  
⇒ We definitely aim for customer relevance

The image displays three e-commerce search results for the query "phillips fernseher mit ambilight und dolby atmos".




- MediaMarkt:** Shows a sidebar with filters for "Kategorie" (TV & Audio (3)), "Kundenbewertung" (5-star: 1, 4-star & mehr: 3, 3-star & mehr: 3, 2-star & mehr: 3, 1-star & mehr: 3, Alle Bewertungen), "Verfügbarkeit" (auf Lager (3)), and "Bildschirmdiagonale". The main content area shows "Online Shop Ergebnisse (3)" with a list of products.
- SATURN:** Shows a sidebar with filters for "Angebote", "Tarifwelt", "Computer + Tablet", "Büro + Kommunikation", "Smartphone + Tarife", "Kameras + Foto", "Gaming + VR", and "TV + Beamer". The main content area shows "ONLINESHOP" results with a list of products.
- amazon.de:** Shows a search bar with the query "phillips fernseher mit ambilight und dolby atmos". The results show "Ergebnisse mit weniger Wörtern anzeigen." and "Keine Ergebnisse für phillips fernseher mit ambilight und dolby atmos". Below this, it shows "phillips fernseher mit ambilight und dolby atmos" results, including a Philips HTL3140B/12 Soundbar-Lautsprecher and a Sony KD-49XE7004 Bravia 123 cm (49 Zoll) Fernseher.

# Search Management

What is relevance... for a consumer electronics e-shop?

There is definitely a lot more to consider than simply keyword matching:

- Assortment Issues (EOL / alternatives / accessories): “samsung galaxy s5”
- Inventory turnover rate / multi-channel dependencies: “tv 55 zoll”
- Margin in consumer electronics: “hp 301”
- ...

<p>★★★★★ (58)</p> <p><b>HP 301 Tintenpatrone Schwarz</b> von HP</p> 	<p>★★★★★ (11)</p> <p><b>HP 301XL Tintenpatrone Schwarz (CH56)</b> von HP</p> 	<p>★★★★★ (63)</p> <p><b>HP 301 Tintenpatrone 2er-Pack Schwarz/Cyan/Magenta/Gelb (N9J72AE)</b> von HP</p>  <p>Tinten/Tonertyp <b>Tintenpatrone</b></p> <p>Farbe <b>Schwarz/Cyan/Magenta/Gelb</b></p> <p>Tinten/Tonermenge (metrisch) <b>3 ml</b></p> <p>OEM-Patronennummer <b>N9J72AE</b></p> <p>● <b>Online auf Lager</b> Nur noch wenige Stück verfügbar</p> <p>● <b>Sofort abholbereit</b> im MediaMarkt Berlin-Mitte im Alexa (<a href="#">Markt ändern</a>)</p> <p><b>33.99</b> <small>inkl. MwSt. zzgl. Versand</small></p>
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⇒ All in all the aim of search management is to find a “*sweet spot*” between customer relevance and business goals that should be realized through the search.

# nDCG

The NDCG expresses the similarity of an actual ranking to the ideal ranking of a list



Berlin-Hauptbahnhof >

5 Suchergebnisse für resident evil ps4

Online Markt



**53.99**

inkl. MwSt. zzgl. Versand

★★★★★ (74)

**Resident Evil 2 [PlayStation 4]**

von CAPCOM ENTERT. GERMANY GMBH

Online Markt



**23.99**

inkl. MwSt. zzgl. Versand

	A	B	C	D	E
	Index	Evaluation+CG	DCG	Harmonized	IDCG
1	1	3	4.982892142	3	4.982892142
2	2	2	2.21461873	3	3.321928095
3	3	2	1.660964047	3	2.491446071
4	4	0	0	3	1.993156857
5	5	1	0.553654682	2	1.107309365
6	6	1	0.474561156	2	0.949122313
7	7	1	0.415241012	1	0.415241012
8	8	3	1.107309365	1	0.369103122
9	9	3	0.996578428	1	0.332192809
10	10	3	0.90598039	0	0
11		19	13.31179995	19	15.96239179
12					
13					
14					
15					
			<b>nDCG 83.39%</b>		

- Bandwidth chosen by tester based on product know-how / plausibility
- Score on product & position level
- Objectivity given through clear criteria for scoring

⇒ nDCG in TOP 100 about 98%

[https://en.wikipedia.org/wiki/Discounted\\_cumulative\\_gain](https://en.wikipedia.org/wiki/Discounted_cumulative_gain)

# “Wisdom of the crowd” precision

“Matching” and “Ranking” as objective criteria to be judged by testers

Good	Good
------	------

- **90,95 %**
- The right articles were found in the expected order

Medium	Good
--------	------

- **4,54 %**
- 1/3 Assortment problems (EOL, Alternatives)
- 1/3 Product data problems
- 1/3 Search optimisation needed

Medium	Medium
--------	--------

- **1,87 %**
- 2/3 Search optimisation needed
- 1/3 Assortment problems (EOL, Alternatives) + Content

Medium	Bad
--------	-----

- **0,42 %**
- 2/3 Assortment problems (EOL, Alternatives) + Content
- 1/3 Search optimisation needed

Bad	Bad
-----	-----

- **1,72 %**
- 2/3 Assortment problems (EOL, Alternatives)
- 1/3 Search optimisation needed

Bad	Good
-----	------

- **0,50 %**
- 2/3 Assortment problems (EOL, Alternatives) + Content
- 1/3 Search optimisation needed

Good	Good
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Q2 2018  
Q4 2018  
Q1 2019

81,71%  
82,76%  
87,50%

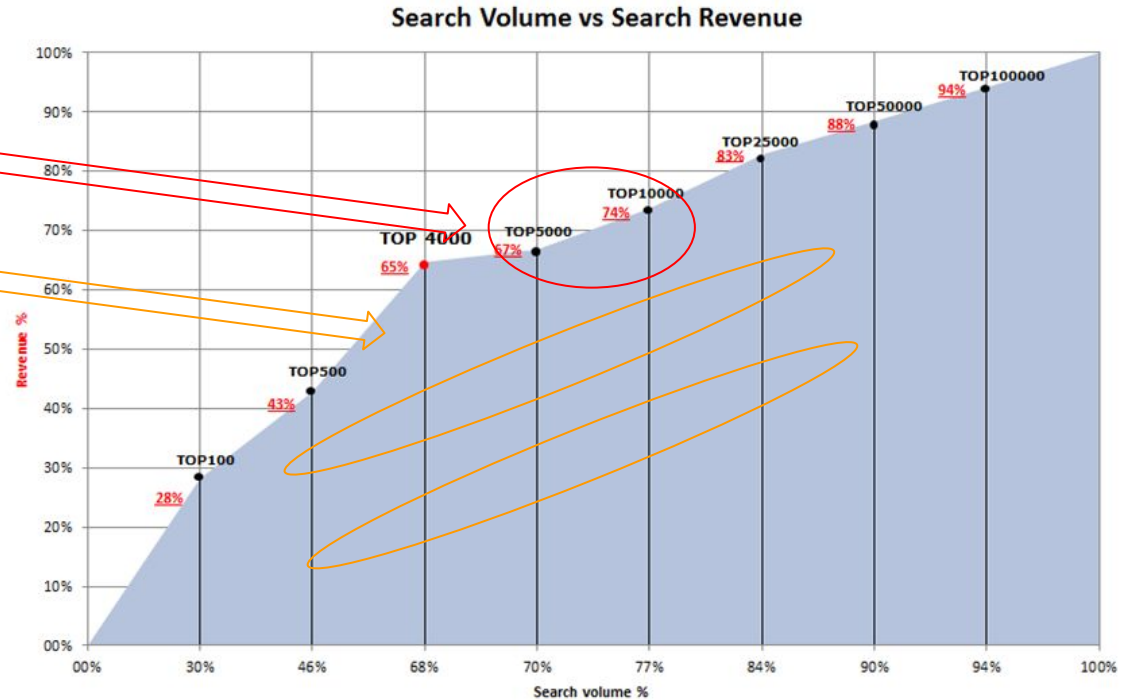
**TOP 4000**

[https://en.wikipedia.org/wiki/Wisdom\\_of\\_the\\_crowd](https://en.wikipedia.org/wiki/Wisdom_of_the_crowd)

# Search Management

## scope & limitations

- Short-head query area
- “Grenze des Wahnsinns”
  - Indirect search optimisation
- Segment Incursion
  - Long tail queries (> n words)
  - Semantic queries
    - Price range: [here](#)
    - Product with feature: [here](#)
- High manual effort
  - Testing
  - Documentation
  - Optimisation
  - Reporting





# Search Management

## Automatisation as challenge / Inspirations

### ASO - Automatic Search Optimisation

**FACT-Finder®**  
Europe's leading conversion engine

- clicks, carts and purchases after search are registered via events and articles are globally re-ranked

5	<div><div></div><div></div></div>	99,81%	<div>?</div>		D5300 Kit	2096837	SaturnDEdece3143628
	Gesamtähnlichkeit Gefundene Begriffe Gefunden in	Spiegelreflexkamera <sup>+</sup> Typ	Einfluss des Rankings Veränderung des Rankings	-1,25% +10 (von 15 nach 5)	Einfluss des Semantic Enhancers Einfluss der ASO	+1% +0,51%	
6	<div><div></div><div></div></div>	99,77%	<div>?</div>		EOS 4000D Kit	2396020	SaturnDEdece4946062
	Gesamtähnlichkeit Gefundene Begriffe Gefunden in	Spiegelreflexkamera <sup>+</sup> Typ	Einfluss des Rankings Veränderung des Rankings	-0,9% -1 (von 5 nach 6)	Einfluss des Semantic Enhancers Einfluss der ASO	+1% +0,12%	



# Search Management

## Automatisation as challenge / Inspirations

### BigQuery scoring model Dashboard (v1)

- clicks, carts and purchases after search are registered via events and articles are re-ranked per query
- Price segment also taken into account for overall scoring

Weighted score for selected date

productsk u	productname	Score	Score relative
2396073	SAMSUNG UE55NU7179UXZG, 138 cm , UHD 4K, SMART TV,	1.272,50	10,0
2459852	PHILIPS 55PUS6703/12, 139 cm , UHD 4K, SMART TV, L	651,70	5,1
2509934	SAMSUNG UE55NU7099BXZG, 138 cm , UHD 4K, SMART TV,	539,80	4,2
2396757	OK. ODL 55650U-TIB, 139 cm , UHD 4K, SMART TV, LED	398,50	3,1
2391603	LG 55UK6470PLC, 139 cm , UHD 4K, SMART TV, LED TV,	193,15	1,5
2400420	OK. ODL 55651U-TIB, 140 cm , UHD 4K, SMART TV, LED	43,00	0,3
2396076	SAMSUNG UE40NU7199UXZG, 100 cm , UHD 4K, SMART TV,	36,21	0,3
2469526	SAMSUNG UE50NU7099UXZG, 125 cm , UHD 4K, SMART TV,	34,80	0,3
2380119	GRUNDIG 55 GUB 8862, 139 cm , UHD 4K, SMART TV, LE	33,01	0,3
2436560	SAMSUNG UE55NU8009TXZG, 138 cm , UHD 4K, SMART TV,	29,69	0,2
2444739	LG 55SK8000PLB, 139 cm , UHD 4K, SMART TV, LED TV,	26,04	0,2
2469524	SAMSUNG UE65NU7099, 163 cm , UHD 4K, SMART TV, LED	24,62	0,2
2396072	SAMSUNG UE65NU7179UXZG, 163 cm , UHD 4K, SMART TV,	23,08	0,2
2474601	LG OLED55B87LC, 120 cm , UHD 4K, SMART TV, OLED TV,	20,85	0,2
<b>Gesamt</b>		<b>3.414,80</b>	<b>26,8</b>

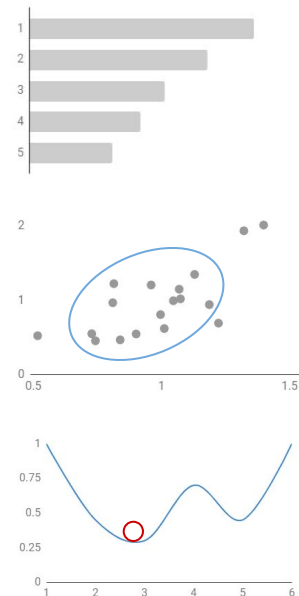
# In a nutshell...

- We aim for customer relevance (keyword matching) ...
- ... but there is a lot more to consider (relevance)
- We have running models/processes that give a good overview over short-head query area ... (nDCG / wisdom of the crowd)
- ... but that is archived with significant manual effort
- Automatisations is a challenge
  - Understanding and managing long-tail query area better
  - Sorting of true positives inside search result

# Requirements and goals

## The ideally ranked search result list

- Displays relevant **products** in relation to the **search query** from the average user's point of view
- Assesses product relevance by the **inherent value** which is untainted by short-term events
- Is able to improve towards a **best possible position** independent from a good or bad starting point



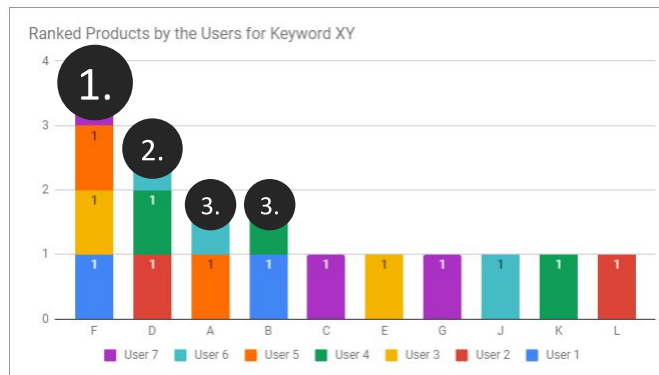
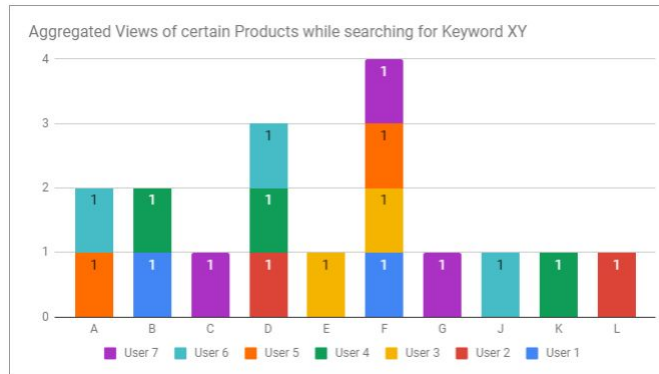
# The collaborative scoring model

Let's assume that...

- We sell 10 different products (A, B, C, ... L )
- They can be found by entering the search query “XY”

→ How do we define what's the most relevant product?

# What's important for our customers?



But we do not only evaluate what products our customers are looking at in detail...

Product score for one search query =

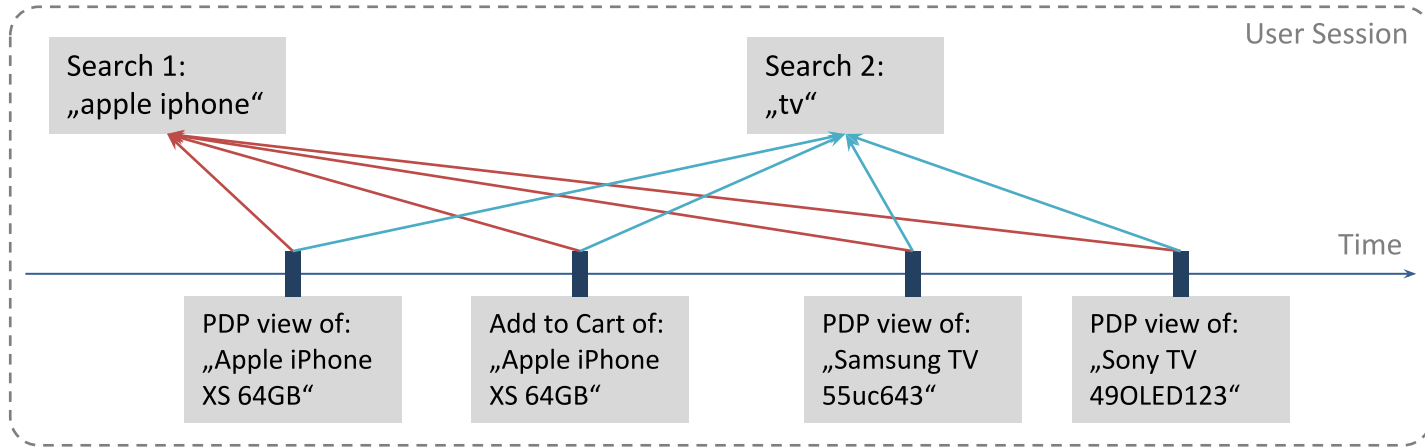
$$\left( \begin{array}{c} \text{Detail view} \\ \times \\ \text{Detail view weight} \end{array} \right) + \left( \begin{array}{c} \text{Add-to-cart} \\ \times \\ \text{Add-to-cart weight} \end{array} \right) + \left( \begin{array}{c} \text{Purchase} \\ \times \\ \text{Purchase weight} \end{array} \right)$$

Weights

purchases / detail views      purchases / add-to-carts      purchases / purchases

The diagram illustrates the calculation of a product score for one search query. The score is calculated as the sum of three weighted actions: Detail view, Add-to-cart, and Purchase. Each action is multiplied by its respective weight. A timeline at the bottom shows the sequence of weights: purchases / detail views, purchases / add-to-carts, and purchases / purchases.

# It is important to prevent the current search result list to predetermine the new ranking



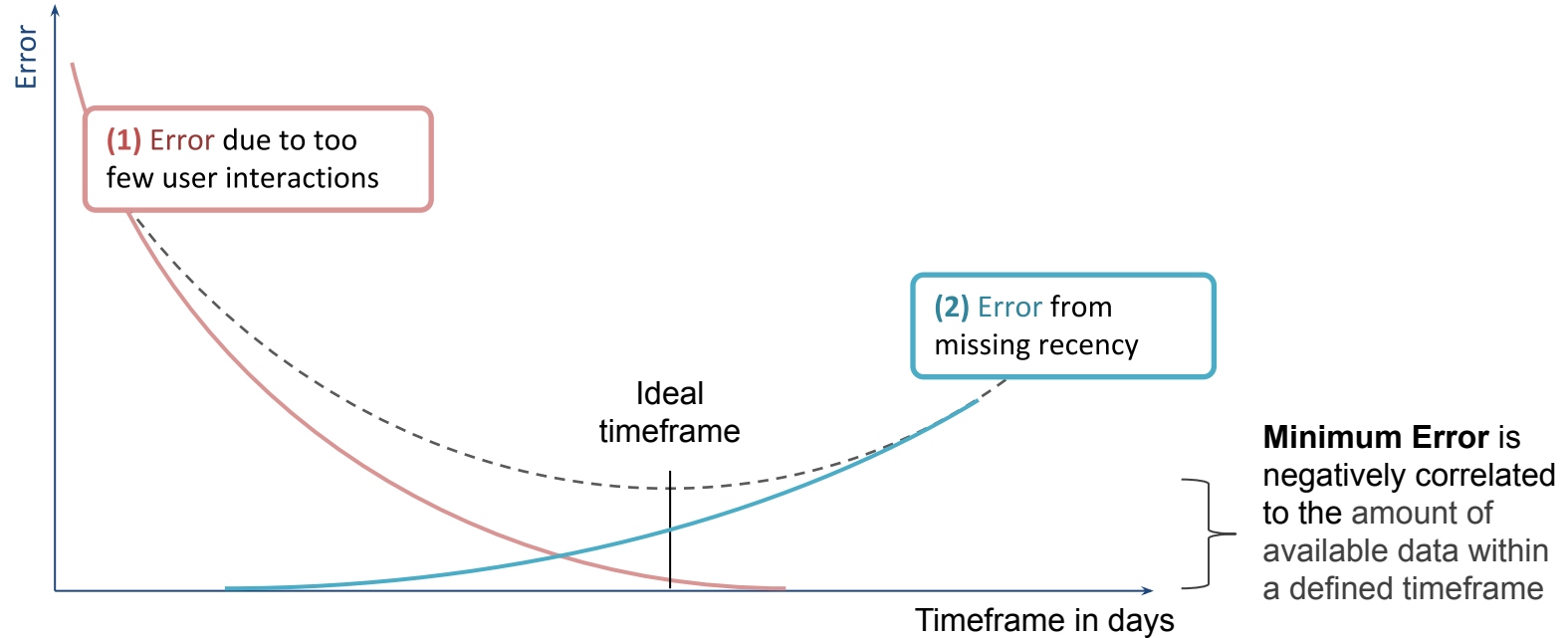
Search 1: „apple iphone“

- PDP view of: „Apple iPhone XS 64GB“
- Add-to-Cart of: „Apple iPhone XS 64GB“
- PDP view of: „Samsung TV 55uc643“
- PDP view of: „Sony TV 49OLED123“

Search 2: „tv“

- PDP view of: „Apple iPhone XS 64GB“
- Add-to-Cart of: „Apple iPhone XS 64GB“
- PDP view of: „Samsung TV 55uc643“
- PDP view of: „Sony TV 49OLED123“

# Two types of errors regarding the selected time window can occur



→ What about short-term or long-term advertising campaigns?



# Should I better buy smartphone A or B?

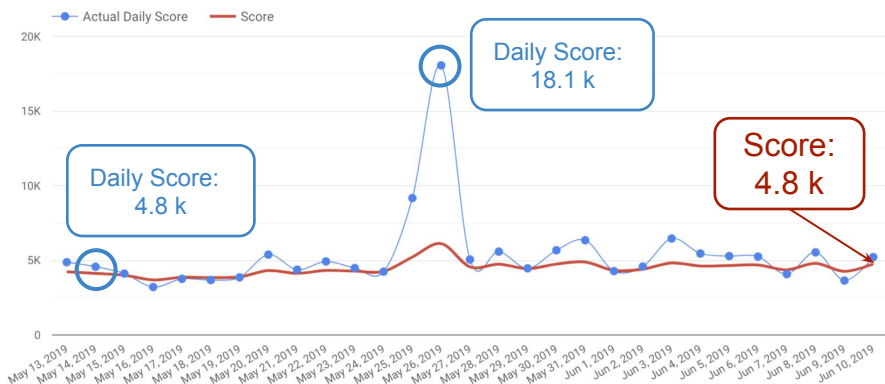
We asked thousands of users...

$$\text{Score} = m + m * \text{Log}_{20}(ds / m)$$

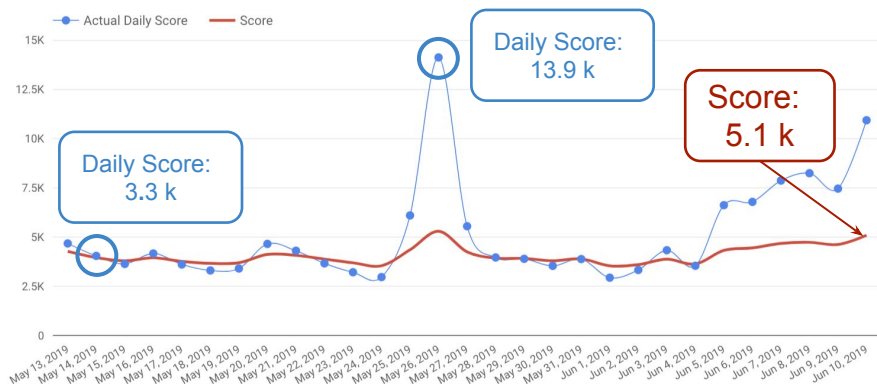
m: rolling Score Median

ds: Daily Score

Product:  
Apple iPhone XR 64GB Black



Product:  
Apple iPhone 8 64GB Space Gray



Intention: rank up products with a high relevance to the search query

- Effects from **advertising campaigns** should not influence product score
- But: **long-term changes** in price or product popularity should influence the score

# Model evaluation 1/3

For the generic search query “waschmaschine”

## Collaborative filtering

Fucus on user interaction with decreasing relevance

Recommended Ranking

keyword rank	search_keyword	productsku	ranking product	productname	Score relative	product availability
5	waschmaschine	2399455	1	BAUKNECHT FWM 7F4 Waschmaschine	10.0	1.0
5	waschmaschine	2153338	2	SAMSUNG WW 80 J 34 D0KW/EG Waschmaschine	9.3	1.0
5	waschmaschine	2411226	3	OK. OWM 16112 A3 Waschmaschine	7.0	1.0
5	waschmaschine	2464870	4	OK. OWM 15012 A2 Waschmaschine	4.2	1.0
5	waschmaschine	2313944	5	SIEMENS WM14N121 Waschmaschine	3.7	1.0
5	waschmaschine	2318583	6	BOSCH WAN28121 Waschmaschine	3.1	1.0
5	waschmaschine	2439151	7	GORENJE W2E 74S3 P SLIM LINE Waschmaschine	2.1	1.0
5	waschmaschine	2125613	8	SIEMENS WM14E220 Waschmaschine	2.1	1.0
5	waschmaschine	1980735	9	BOSCH WAB28222 Waschmaschine	1.9	1.0
5	waschmaschine	2226981	10	LG F 14WM 8LN0 Waschmaschine	1.3	1.0
5	waschmaschine	1890410	11	SIEMENS WM14W5FCB Waschmaschine	1.1	1.0
5	waschmaschine	2161935	12	SAMSUNG WW70K44205 Waschmaschine	1.0	1.0
5	waschmaschine	2237508	13	SAMSUNG WW70J5435FX/EG Waschmaschine	0.3	1.0
5	waschmaschine	2425942	14	BAUKNECHT AM 8F4 Waschmaschine	0.3	1.0
102					48.5	1.0

## Current search list results

Strong focus on text matching

NDCG

0.77

Comparison between actual displayed positions and the Search Reco Engine ranking

keyword rank	daily unique searches	search keyword	productsku	productname	displayed position	ranking product	Recom. Direction
5	1873	waschmaschine	1890410	SIEMENS WM14W5FCB Waschmaschine	1.00	11.00	▼
5	1873	waschmaschine	2153338	SAMSUNG WW 80 J 34 D0KW/EG Waschmaschine	2.00	2.00	good
5	1873	waschmaschine	2313944	SIEMENS WM14N121 Waschmaschine	3.00	5.00	↔
5	1873	waschmaschine	2399455	BAUKNECHT FWM 7F4 Waschmaschine	4.00	1.00	↔
5	1873	waschmaschine	2411226	OK. OWM 16112 A3 Waschmaschine	5.00	3.00	↔
5	1873	waschmaschine	2318583	BOSCH WAN28121 Waschmaschine	6.00	6.00	good
5	1873	waschmaschine	2425942	BAUKNECHT AM 8F4 Waschmaschine	7.00	14.00	↔
5	1873	waschmaschine	2125613	SIEMENS WM14E220 Waschmaschine	8.00	8.00	good
5	1873	waschmaschine	2161935	SAMSUNG WW70K44205 Waschmaschine	9.00	12.00	↔
5	1873	waschmaschine	1892562	SIEMENS WM16W540	10.00	18.00	↔
5	1873				8.00	8.73	

# Model evaluation 2/3

## For the search query “iphone x”

### Collaborative filtering

Fucus on user interaction with decreasing relevancy

Recommended Ranking

keyword rank	search_keyword	productsku	ranking product	productname	Score relative	product availability
6	iphone x	2335670	1	APPLE iPhone X 64 GB Space Grey	10.0	1.0
6	iphone x	2335672	2	APPLE iPhone X 64 GB Silber	9.8	1.0
6	iphone x	2335674	3	APPLE iPhone X 256 GB Space Grey	6.6	1.0
6	iphone x	2335678	4	APPLE iPhone X 256 GB Silber	3.9	1.0
6	iphone x	2478646	5	APPLE iPhone XS 64 GB Space Gray Dual SIM	2.1	1.0
6	iphone x	2490833	6	APPLE iPhone XR 128 GB Black Dual SIM	2.1	1.0
6	iphone x	2490911	7	APPLE iPhone XR 64 GB Black Dual SIM	2.0	1.0
6	iphone x	2478648	8	APPLE iPhone XS 64 GB Gold Dual SIM	1.8	1.0
6	iphone x	2490838	9	APPLE iPhone XR 64 GB White Dual SIM	1.7	1.0
6	iphone x	2335681	10	APPLE iPhone 8 64 GB Space Grey	1.5	1.0
6	iphone x	2478649	11	APPLE iPhone XS 256 GB Space Gray Dual SIM	0.9	1.0
6	iphone x	2478647	12	APPLE iPhone XS 64 GB Silber Dual SIM	0.6	1.0
6	iphone x	2524718	13	SAMSUNG Galaxy S10 128 GB Prism Black Dual SIM	0.6	1.0
6	iphone x	2335701	14	APPLE iPhone 8 Plus 64 GB Space Grey	0.5	1.0
6	iphone x	2478657	15	APPLE iPhone XS Max 64 GB Gold Dual	0.4	1.0
122					45.2	1.0

Common elements  
are Apple iPhone X or similar priced smartphones

### Current Search

Strong focus on text matching, rule based

NDCG

0.72

Comparison between actual displayed positions and the Search Reco Engine ranking

keyword rank	daily unique searches	search keyword	productsku	productname	displayed position	ranking product	Recom. Direction
6	1816	iphone x	2335674	APPLE iPhone X 256 GB Space Grey	1.00	3.00	▼
6	1816	iphone x	2335678	APPLE iPhone X 256 GB Silber	2.00	4.00	▼
6	1816	iphone x	2335672	APPLE iPhone X 64 GB Silber	3.00	2.00	▲
6	1816	iphone x	2335670	APPLE iPhone X 64 GB Space Grey	4.00	1.00	▲
6	1816	iphone x	2378798	BELKIN SheerForce Elite Schutzülle für iPhone X Backcover Apple iPhone X Polycarbonat Schwarz	5.00	21.00	▼
6	1816	iphone x	2383760	CELLULAR LINE 39369 Backcover Apple iPhone X Kunststoff Schwarz/Transparent	6.00	21.00	▼
6	1816	iphone x	2325370	ADIDAS Originals Clear Case Backcover Apple iPhone X Weiß	7.00	21.00	▼
6	1816	iphone x	2338701	BLACK ROCK Camouflage Backcover Apple iPhone X Polycarbonat Schwarz	8.00	21.00	▼
6	1816	iphone x	2325365	ADIDAS Originals Backcover Apple iPhone X Schwarz/Weiß	9.00	21.00	▼
6	1816	iphone x	2382275	BELKIN InvisiGlass Ultra	10.00	21.00	▼
6	1816				6.50	14.83	

Common element  
is the string „iphone x“

# Model evaluation 3/3

## Discover product alternatives for discontinued products

salesline	evaluated_date	search_keyword	median_unique _searches	productsku	productname	score_std	score	days_w_data _ratio	
MM-DE	2019-03-31	samsung galaxy s7	558	2103689	SAMSUNG Galaxy S7 32 GB Black-Onyx	100.0	2034.35	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2143180	SAMSUNG Galaxy S7 32 GB Pink-Gold	44.7	909.30	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2482491	SAMSUNG GALAXY A7 64 GB Schwarz Dual SIM	41.9	851.60	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2246306	SAMSUNG Galaxy S8 64 GB Midnight Black	34.5	701.20	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2132283	SAMSUNG Galaxy S7 32 GB Silver-Titanium	33.0	670.87	0.89	
MM-DE	2019-03-31	samsung galaxy s7	558	2103691	SAMSUNG Galaxy S7 32 GB White-Pearl	27.1	552.10	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2246308	SAMSUNG Galaxy S8 64 GB Orchid Grey	23.5	478.05	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2103688	SAMSUNG Galaxy S7 32 GB Gold-Platinum	16.2	329.40	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2391195	SAMSUNG Galaxy S9 64 GB Midnight Black Dual SIM	14.2	288.25	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2414424	SAMSUNG Galaxy A6 32 GB Black Dual SIM	14.2	287.92	0.91	
MM-DE	2019-03-31	samsung galaxy s7	558	2482488	SAMSUNG GALAXY A7 64 GB Gold Dual SIM	11.5	234.30	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2482490	SAMSUNG GALAXY A7 64 GB Blau Dual SIM	11.5	233.20	1.00	
MM-DE	2019-03-31	samsung galaxy s7	558	2246307	SAMSUNG Galaxy S8 64 GB Arctic Silver	6.7	135.68	0.80	
MM-DE	2019-03-31	samsung galaxy s7	558	2357827	SAMSUNG Galaxy S8 64 GB Coral Blue	6.4	130.25	0.80	
MM-DE	2019-03-31	samsung galaxy s7	NEW	558	2524718	SAMSUNG Galaxy S10 128 GB Prism Black Dual SIM	6.2	126.65	0.83
MM-DE	2019-03-31	samsung galaxy s7	558	2358019	SAMSUNG Galaxy S8 64 GB Rose Pink	6.0	122.69	0.83	
MM-DE	2019-03-31	samsung galaxy s7	558	2400478	HUAWEI P20 Lite 64 GB Midnight Black Dual SIM	2.0	40.20	0.65	

salesline	evaluated_date	search_keyword	median_unique_searches	productsku
MM-AT	2019-03-31	samsung galaxy s7	36	14805
MM-AT	2019-03-31	samsung galaxy s7	36	15663
MM-AT	2019-03-31	samsung galaxy s7	36	16822
MM-AT	2019-03-31	samsung galaxy s7	36	15663
MM-AT	2019-03-31	samsung galaxy s7	36	16913
MM-AT	2019-03-31	samsung galaxy s7	36	15278

### Respects customers preference regarding

1. Device Type ✓
2. Brand ✓
3. Price ✓
4. Color ✓

+ enables exploration of new products

### High-traffic saleslines: MediaMarkt Germany

#### Prices

- S7: 325 €
- A7: 259 € (-20%)
- A6: 214 € (-34%)
- S8: 419 € (+29%)
- S9: 526 € (+62%)
- S10: 899 € (NEW)
- P20 lite: 229 € (-30%)

### Mid-traffic saleslines: MediaMarkt Austria

#### Prices

- S7: 347 €
- S8: 419 € (+20%)
- A7: 259 € (-25%)
- S8+: 599 € (+73%)
- Note8: 499 € (+44%)
- iPhone 6s: 349 € (+0%)

# Pros and cons

## Pros

- Up-to-date nDCGs are available every day
- Less manual work for the nDCG evaluation
- Higher nDCGs accuracy by taking into account user interactions
- Product alternatives can be calculated and displayed

## Cons

- A certain inaccuracy if two search queries regularly occur together
- A lot of user interaction data is needed to achieve good results

# What's next?

Each step in the development of the new Search Engine becomes measurable

## Until now: Dashboarding

- Daily recognition of potentially bad rankings
- Easily finding of good product alternatives for discontinued products

## Now: Data driven field optimization (new search engine)

- Recognize false negatives (products) regarding to a certain search query
- Test several field configurations with a quality indication

## Next: Automated relevance optimization (new search engine)

- Improve relevance for the long tail
- Integrate highly relevant alternative products automatically
- Learn field weights that maximizes the average nDCG

nDCG

Query\_Product\_Score = Field\_A \* weight\_A + Field\_B \* weight\_B + Prod\_popularity \* weights\_Pp

# Thank you!

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