Why data-driven methods will shape the future of relevance search

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Is relevance search an art?
“The Birth Of Venus”
Sandro Botticelli
How Search teams are created?

- Search capabilities are created by demand
- Initially, teams focused only on technical aspects
- Attention to search quality comes much later
Pain problems

- The lack of planning ahead leads to restricted growth
- You have a good team of engineers, but you lack expertise in search quality
- The complexity of search relevance tasks increase exponentially over time
Understanding relevance search

- What should not happen
  - You are retrieving items that are not relevant
  - You are missing relevant items
  - You are not showing the most relevant items first
Some steps into relevance search

- TF-IDF, Okapi BM25
- multifield matching, boosting
- phrase matching, query matching, fuzzy matching
- text normalizations, stemming
- synonyms, taxonomies, ontologies
- rules and exceptions!
How easy is it to maintain control over all these parameters?
Relevance Search is a complex task!

“Convergence”
Jackson Pollock
How is your organization prepared for the future?

- Disruptive Digital Innovation
- New Products
- New Categories
- New Markets
- Internationalization
- Fast adaptation!

“Love is in the Bin”
Banksy
Can relevance search be more science?
A Data Science?
Using Data to Leverage your Search Results

- Search logs
- Click-through logs
- Navigation logs
- User preferences
- AB Testing
- External sources

“The Tax Collectors”
Quentin Massys
Machine learning is just a mathematical function!

\[ x = \text{Input Data} \rightarrow y \mapsto f(x) \rightarrow y = \text{Prediction} \rightarrow y' = \text{True Data} \]

“Portrait of Leonhard Euler”
Jakob Emanuel Handmann
Using machine learning to build better search engines

- Traditional Approach
  - Autocomplete
  - Query Understanding
  - Query Expansion
  - Relevance Re-scorer
  - Ranking
Using machine learning to build better search engines

- Modern Approach
  - End-to-End Product Search with Deep Learning
Why should we favor a more traditional architecture?

- Traditional architecture for search still very solid and tested in the industry
- This architecture is easily interpreted and changed to support business needs.
The path to a data-driven search engine
Autocomplete suggestions

- Field-based Autocomplete
- Phrases database Autocomplete
- Language Modeling
  - Hidden Markov Models
  - Neural Language Modeling
Neural language modeling

The same approach could also work on character level.
Neural language modeling

- Vector representation of words
  - Word2vec
  - Query2Vec

- Unbounded vocabulary and sentence sizes

- Possible adaptation to deal with spellings and different words


“Bedroom in Arles” Vincent van Gogh
Query understanding

- Percolate Query
- Named-entity Recognition
  - Conditional Random Fields (CRF)
  - Neural named-entity recognition
Neural named-entity recognition

Neural named-entity recognition

- State-of-the-art
- Open-source libraries available
- Flexible to word variations and misspellings
- Usually requires manually labeled training data

“Woman with a Dog”
Pablo Picasso
Query expansion and retrieval

- Additional knowledge
  - Facets
  - Synonyms, similar words
  - Taxonomy, ontologies, knowledge graphs
  - Graph-based techniques

![Diagram showing query expansion and retrieval process]

Annotated Query → Query Expansion → Q1, Q2, Q3, Q4 → Retrieval
Graph-based techniques

Queries

Query A
Query B
Query C
Query D

Products

Product 1
Product 2
Product 3
Product 4
Product 5

Bipartite graph
Graph-based techniques

- Similar queries
- Similar products
- Vector propagation
- Graph embedding


“Moses by the red sea”
Michael Tingsgård
Relevance Re-scorer

- Score function is a parameterized model
- One may use click logs to train the parameters
- A threshold cut may also be learned by machine learning

\[ y = \lambda_1 Q_1 + \lambda_2 Q_2 + \lambda_3 Q_3 + \lambda_4 Q_4 \]
Learning to Rank algorithms

- RankSVM
- LambdaRank
- LambdaMART
- ConvRankNet
Relevance search as a mathematical function

- Every component of our search architecture is a function
- A composition of functions is also a function
Adapting to new conditions

- The data used for training our relevance search could be conditioned in any particular interest
  - User segment / Specific users
  - Marketing campaigns
  - Regionality
Multiple models

- One could also aggregate multiple search functions

\[ x = \text{query} \]

\[ y \mapsto (f \circ g)(x) \]

\[ y = \text{results} \]
Wrap Up

- Companies with significant volume of Search use should focus more on data-driven search methods as a way of scaling and opening new markets.
- Data Scientists are important to provide data-driven approaches to your Search.
- Relevance Engineers are still important to track your Search quality and provide search adjustments quickly.
Relevance search is a science and an art!
Data-driven methods are the future of relevance search

“Portrait of Edmond de Belamy”
AI generated
Sold in 2018 for over $400,000
Thank You!

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