Linking FRBR Entities to LOD through Semantic Matching

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- Vast amount of valuable (and thoroughly documented) metadata in library catalogs
- Need for a transition to semantic formats
- Transition requires a great deal of quality assurance
- Many applications utilizing Linked Open Data

Outline

1. Introduction
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   - Blocking
   - Matching Process
   - Filtering
   - Discussion
3. Experimental Evaluation
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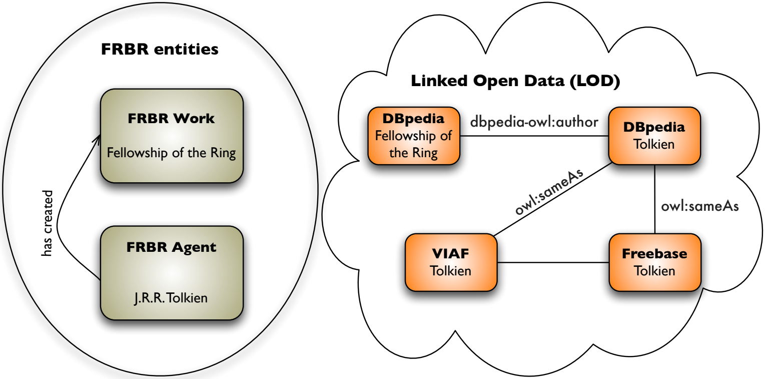
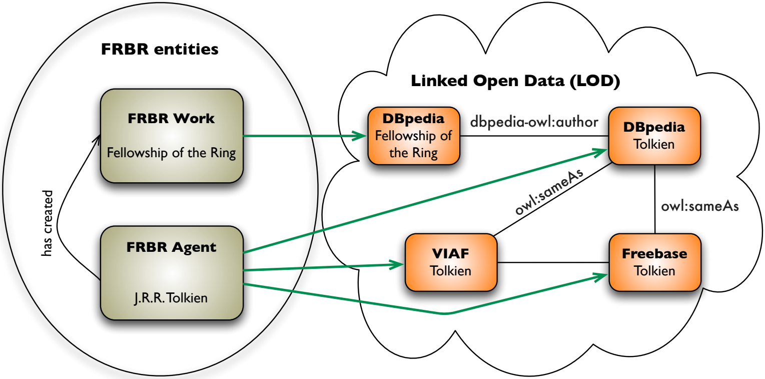
Motivation 1/2

- Enrich and verify FRBR entities with LOD information
- Reuse information and realize potential value of existing metadata
- Connecting FRBR entities to LOD to facilitate information discovery

Motivation 2/2



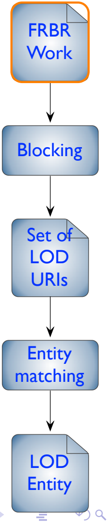
Motivation 2/2



Overview

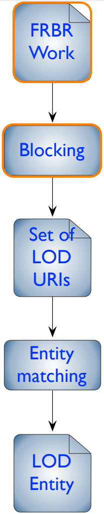
- The problem:
  a set of works $\mathcal{W}$ and a set of LOD entities $\mathcal{L}$;
  for each work $w \in \mathcal{W}$ and $l \in \mathcal{L}$, we note $\mathcal{F}$ the set of attributes shared by w and l;
  For an attribute $f \in \mathcal{F}$ shared by w and l, a similarity function is defined:

$$sim_f(w, l) \rightarrow [0, 1]$$



Blocking

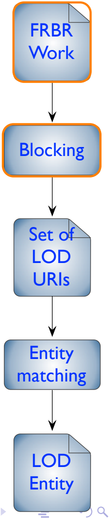
- LOD: millions of entities
  (e.g. Freebase contains ∼12M entities)
- We need a heuristic to select a subset of LOD entities, i.e., reduce the search space



Blocking (2)

- Obtain a subset of LOD entities by querying LOD
- Queries based on the FRBR attributes (e.g. title, date, etc.)
- A set of query tokens for each attribute:

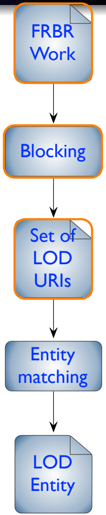
$$\begin{aligned} titles &\rightarrow \{title, normalized\_title\} \\ creators &\rightarrow \{creator_1, ..., creator_k\} \\ types &\rightarrow \{type, ext\_type_1, ..., ext\_type_m\} \end{aligned}$$



Sample queries

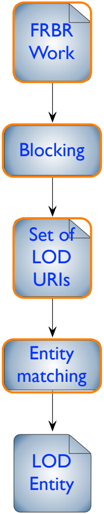
Type of Query	Query	# Entities
title	The fellowship of the ring (LOTR)	0
norm_title	fellowship ring	5
norm_title + ext_type	fellowship ring book	1
norm_title + ext_type	fellowship ring print	0
creator + ext_type	JRR Tolkien book	1
...		

The blocking process has reduced the number of candidate LOD entities against which we can now apply fine-grained matching techniques.



Matching (1)

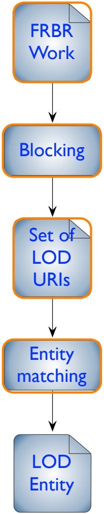
- Given a (reduced) set of LOD entities we need to match against FRBR entities
- Common attributes
  (name, creator, type, category, date of creation)
- Some attributes exist on both FRBR and LOD entities, while the others may be lacking



Matching (2)

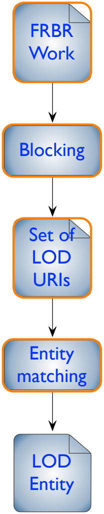
Individual similarity measures between properties of FRBR entity and properties of a LOD entity.

The nature of attributes are different. E.g., the *type* is word from a finite set of values while date can be in variety of formats (3 April 1978, 04.03.1978 or 03.04.1978 etc)

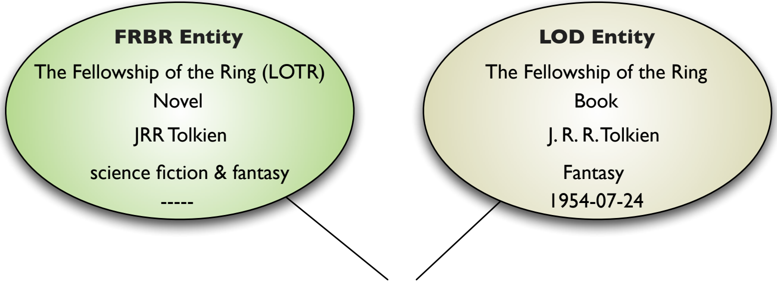


Matching (3)

- Attributes title and creator: three terminological similarity measures (Jaro Winkler, Monge Elkan and Scaled Levenshtein)
- Attribute categories: intersection of the sets of common categories
- Attribute type: using a small Wordnet-based taxonomy, evaluation based on the concepts that appear in the taxonomy
- Attribute date: extract only year as temporal granularity for works, hence the binary individual similarity



Matching (4)



FRBR Entity

The Fellowship of the Ring (LOTR)

Novel

JRR Tolkien

science fiction & fantasy

LOD Entity

The Fellowship of the Ring

Book

J. R. R. Tolkien

Fantasy

1954-07-24

Similarity measures:

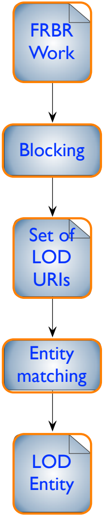
Title:	**0.77**
Type:	**0.29**
Creator:	**0.81**
Categories:	**0.00**
Date:	**0.00**

Matching (5)

- A global similarity value derived from individual ones
- A weighted average function to aggregate the values of all individual similarities
- Flexible with regard to applying weights
- Example: the DBpedia entity *The_Fellowship_of_the_Ring* and the work have a global similarity value equal to 0.37. As a comparison, the DBpedia entity related to the movie *The_Fellowship_of_the_Ring* obtains a similarity value of 0.22.

Filtering Candidate Matches

- Filter the candidate matches using one of the following strategies to filter candidate LOD entities:
  - selecting those with a similarity value above a given threshold
  - type-based constraint (e.g. "book")
  - top-k



Discussion

- Some entities are missing on the LOD
- Due to variations in the spellings and depending on the filter threshold, sometimes no LOD entity is returned by the blocking process, although the corresponding LOD entity might exist
- Not only used for verification purposes, but can also be a ground for adding new entities to the LOD
- A validation step is important

Experiment Protocol

- DBpedia Lookup Engine[1] as blocking process to reduce the set of DBpedia results as a set of candidates
- 684 FRBR works (extracted from product information found on Amazon), 343 with corresponding DBpedia entity
- Eight human judges performed manual validation

[1] http://lookup.dbpedia.org/api/search.asmx/KeywordSearch?QueryString=berlin

Quality Results

	Top-1	**Top-2**	**Top-3**
Number of True-Positives	**189**	197	201

Most of the correct matches (189) are ranked at the top. At top-3, we only discover 12 more entities.

Impact of threshold

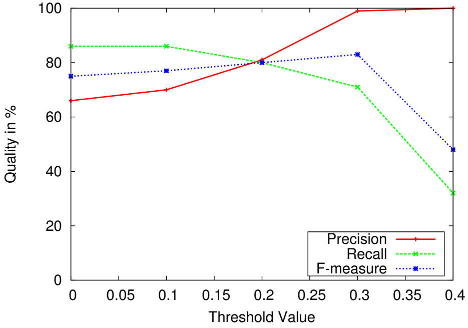


Figure: Quality Results (precision, recall, f-measure) w.r.t. a Threshold Filter

Impact of Weights

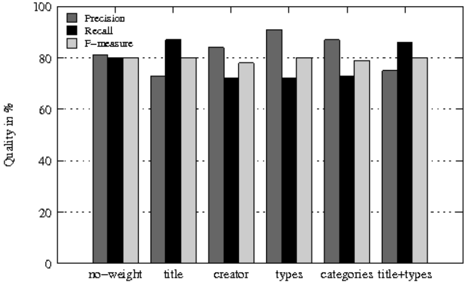


Figure: Quality Results w.r.t. the Weights of Individual Similarities

Conclusion

- A methodology to link a FRBR entity to its corresponding LOD entity
- A query builder as blocking process and refined similarity measures as matching process
- Most of the correct results at the top-1
- Verification and semantic enrichment
  - Integrating with various LOD sources
  - Linking an entity to a specialized database (e.g. *MusicBrainz* for music work)

Questions or Comments?

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