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Towards Optimized Multimodal Concept Indexing

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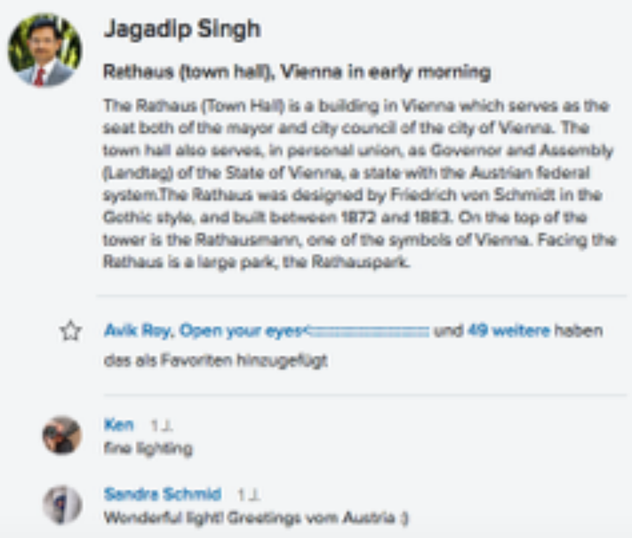
Agenda

- Multimodal Retrieval
  - Social Image Retrieval
  - Mucke Framework
- Concept-based Text Retrieval
  - Semantic Similarity
  - Methodology
  - Experimental Results
- Optimization
  - Two-Phase Process
  - Approximation Nearest Neighbors
- Conclusion

Multimodal Retrieval

- Social Image Retrieval → our focus
  - Images
  - Tags, title, and description
  - Meta-data i.e. user profile and Wikipedia page
  - Key-word search



Jagadip Singh

Rathaus (town hall), Vienna in early morning

The Rathaus (Town Hall) is a building in Vienna which serves as the seat both of the mayor and city council of the city of Vienna. The town hall also serves, in personal union, as Governor and Assembly (Landtag) of the State of Vienna, a state with the Austrian federal system.The Rathaus was designed by Friedrich von Schmidt in the Gothic style, and built between 1872 and 1883. On the top of the tower is the Rathausmann, one of the symbols of Vienna. Facing the Rathaus is a large park, the Rathauspark.

☆ Avik Roy, Open your eyes<::::::::::::::::::::::::::: und 49 weitere haben das als Favoriten hinzugefügt

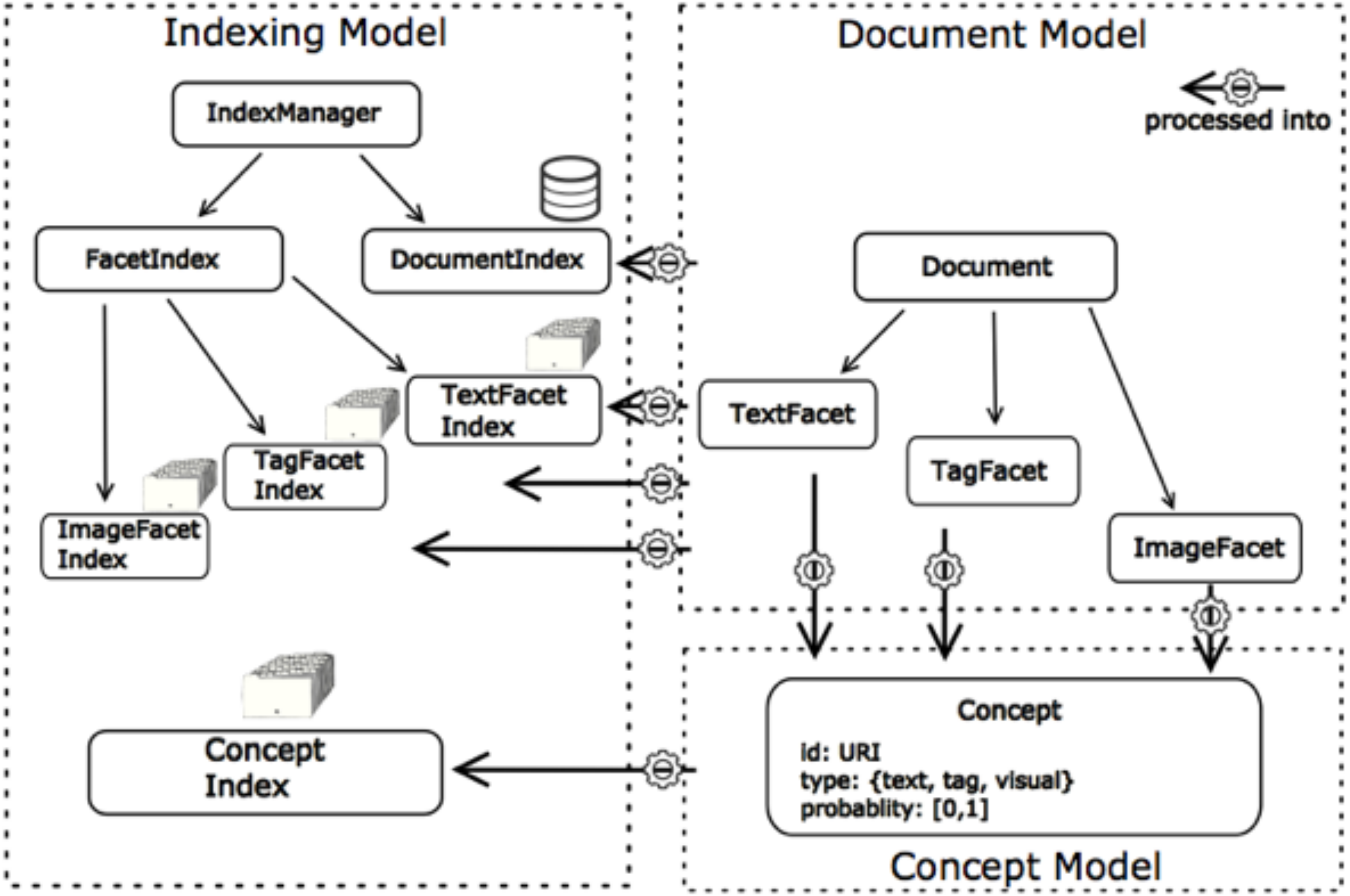
Ken 1 J.
fine lighting

Sandra Schmid 1 J.
Wonderful light! Greetings vom Austria :)

www.flickr.com

Concept-based Multimodal Indexing

- MUCKE Framework



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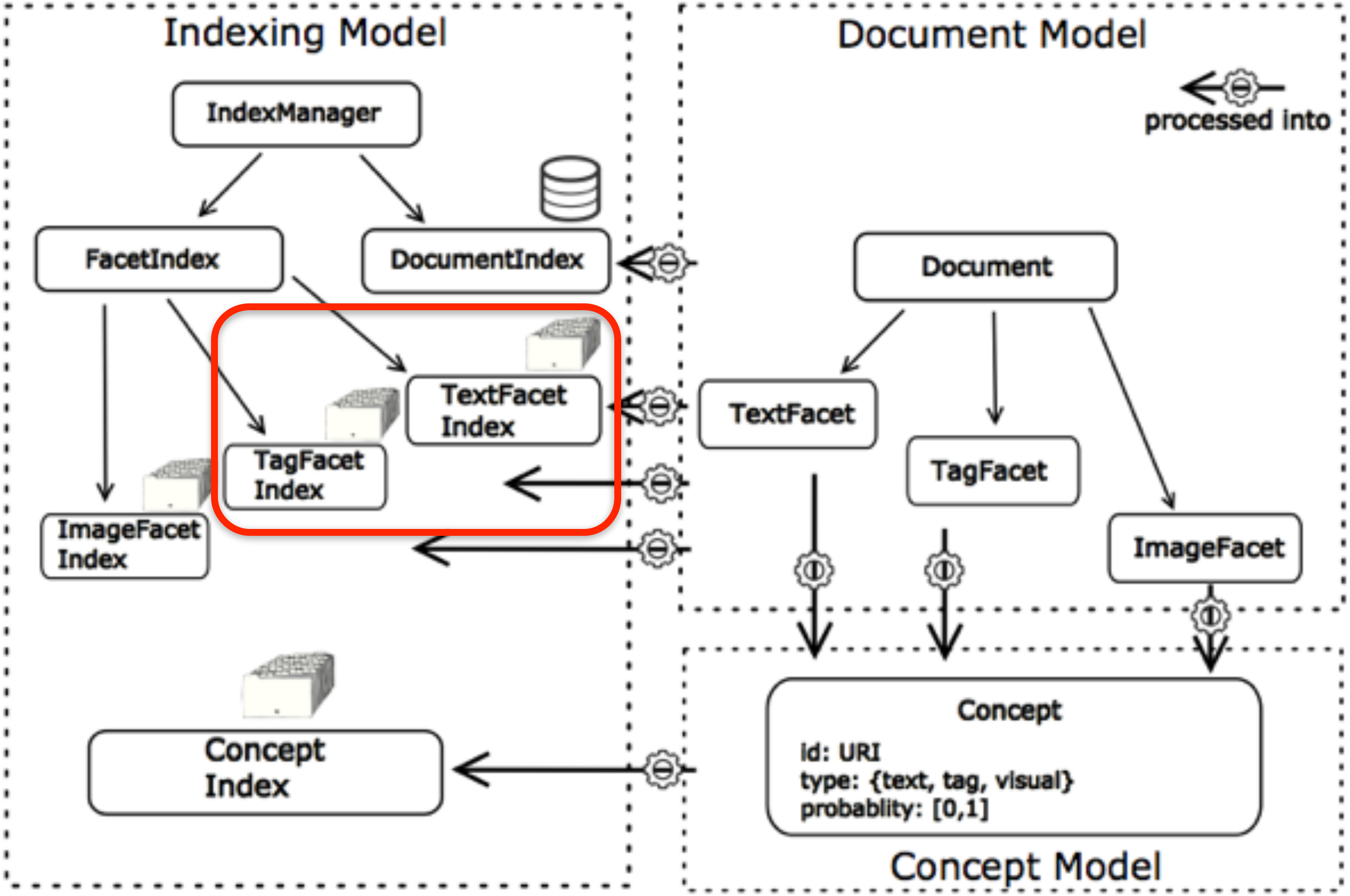

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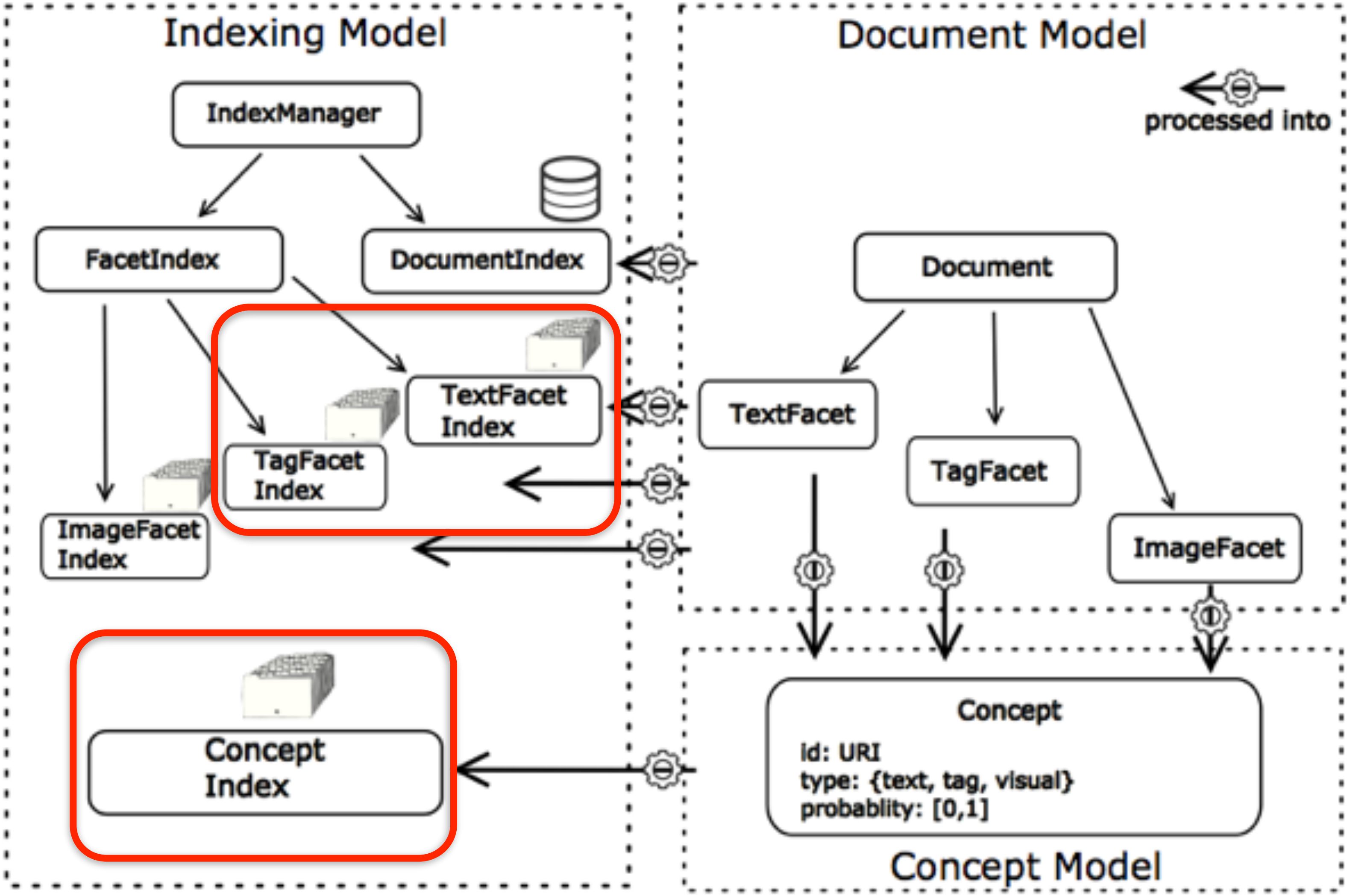

Semantic Similarity

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  - synonyms *(bank, trusted company)*
  - hyponym/hypernym *(skyscraper, building)*
  - antonym *(cold, warm)* etc.

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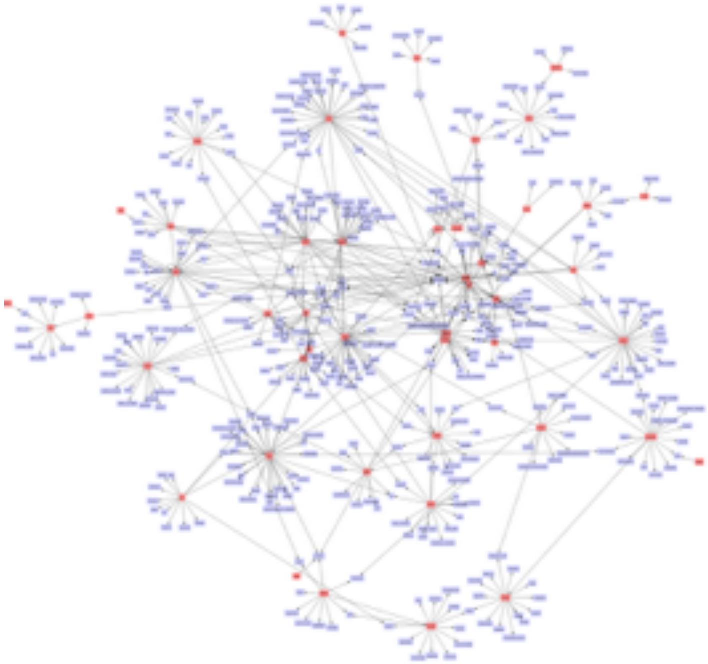
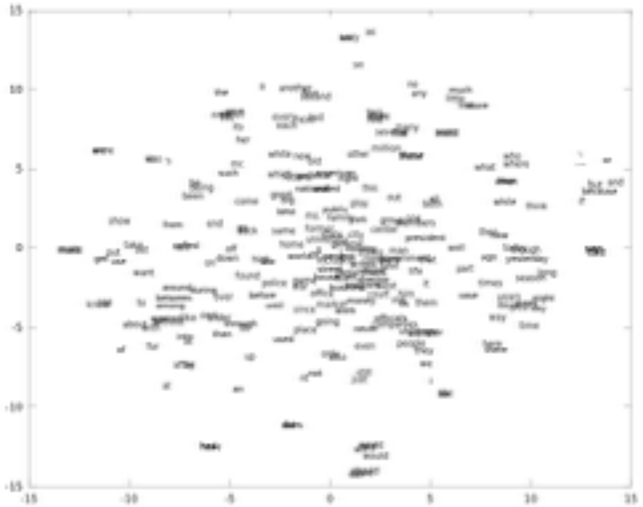
  - Knowledge-based *(WordNet)* vs. Statistical methods





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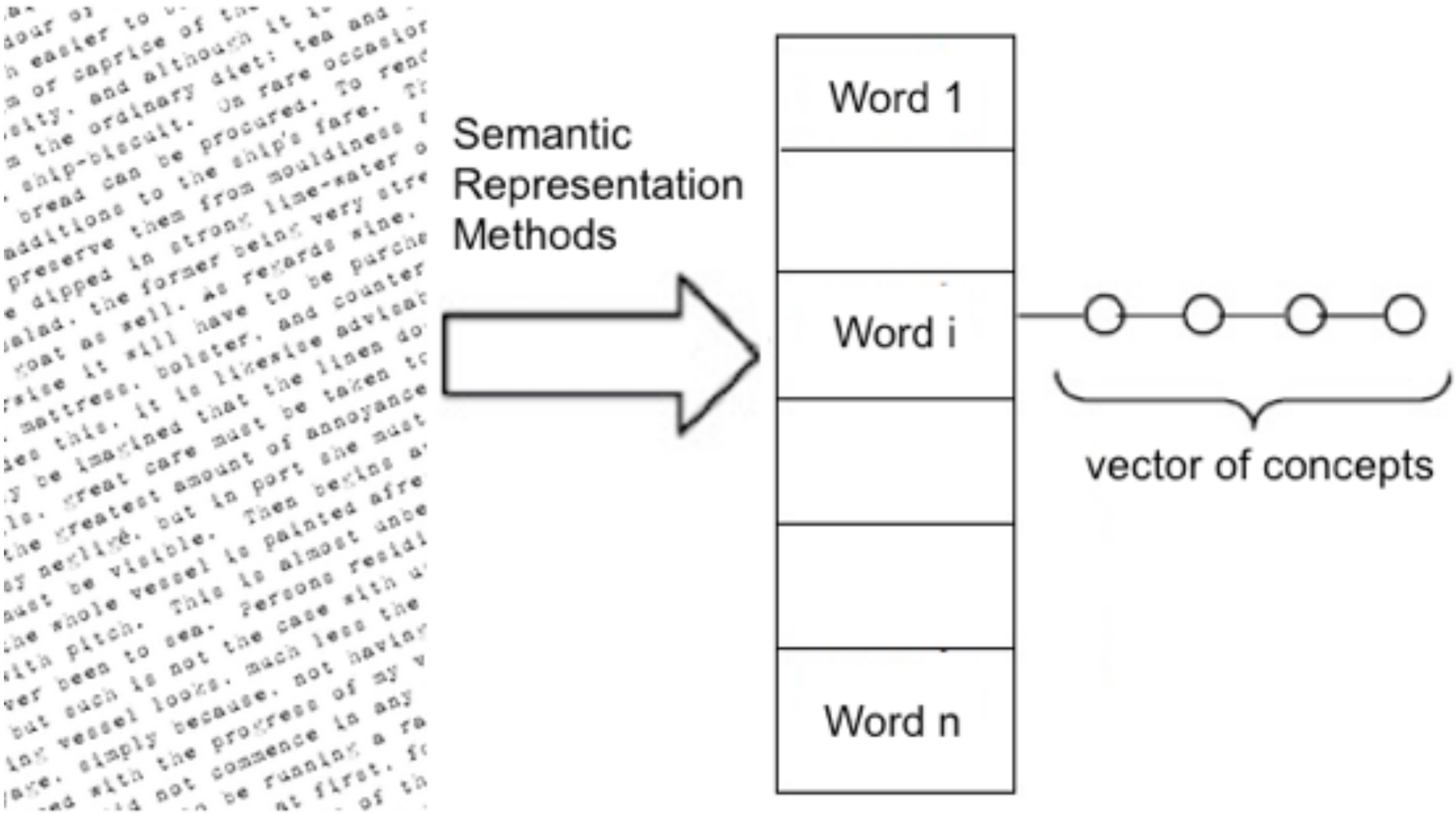
- Statistical Semantic Similarity
  - Semantic Word Representation *(word embedding)*



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- Random Indexing
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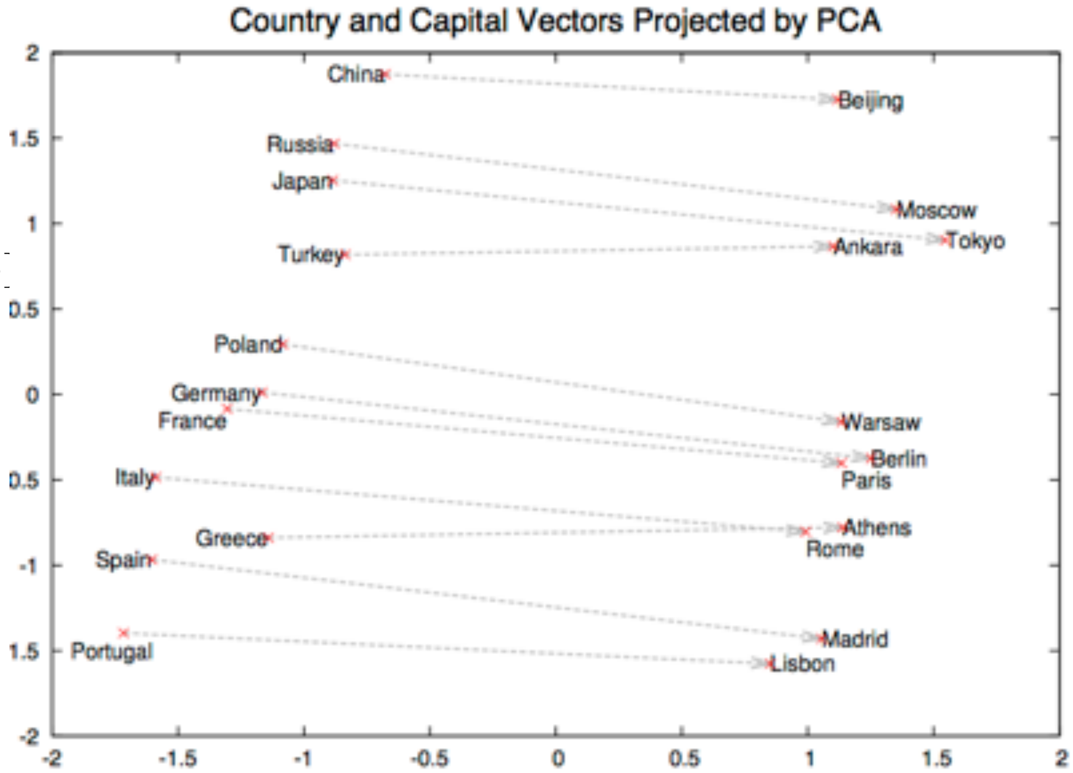
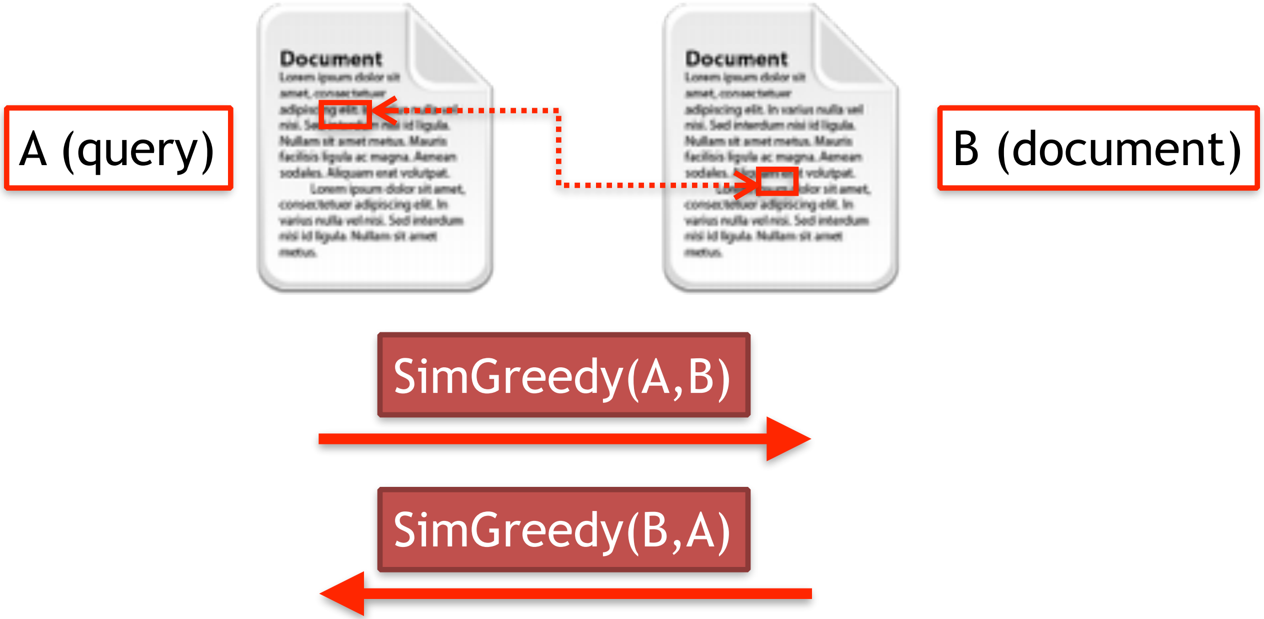
  - Adding word vectors
- Word2Vec [Mikolov 2013]
  - Neural Networks
  - Skip-Gram model



Research Question

- The use of semantic similarity in Social Image Retrieval
  - tags, title, and description of images
  - normal descriptive language
- From semantical Word-to-Word to Text-to-Text similarity
- How to be efficient?

Semantic Similarity Method



A (query)

B (document)

SimGreedy(A,B)

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$$SimGreedy(A,B) = \frac{\sum_{t \in A} idf(t) * maxSim(t,B)}{\sum_{t \in A} idf(t)}$$

$$SimGreedy = \frac{SimGreedy(A,B) + SimGreedy(B,A)}{2}$$

- Refer to as **SimGreedy**
- Complexity: O(n*m)

[1] N. Rekabsaz et al. On the use of statistical semantics for metadata-based social image retrieval (CBMI 2015)

Social Image Retrieval

- MediaEval Retrieving Diverse Social Images Task
  - 600 world landmarks (topics)
  - using textual features (description + tags + title)
  - evaluation metric at P@20

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- MediaEval Retrieving Diverse Social Images Task
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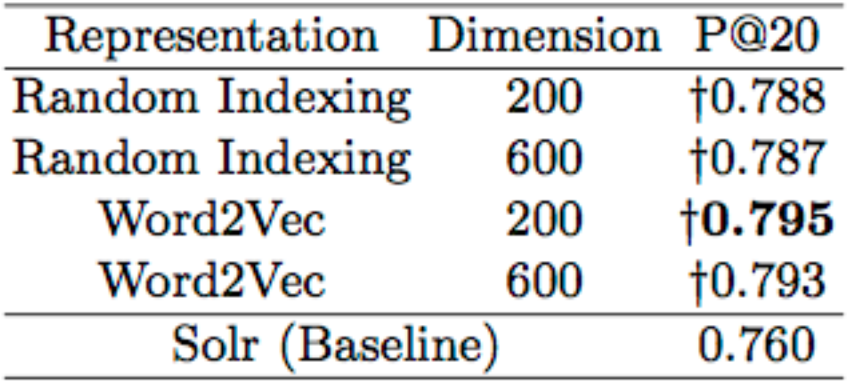
- Experiment setup
  - Training models on Wikipedia corpora
  - Models with RI and Word2Vec representation methods
  - 200 and 600 dimensions
  - Solr as baseline

Social Image Retrieval

- Combination of 2013 and 2014



Representation	Dimension	P@20
Random Indexing	200	†0.788
Random Indexing	600	†0.787
Word2Vec	200	†**0.795**
Word2Vec	600	†0.793
Solr (Baseline)		0.760

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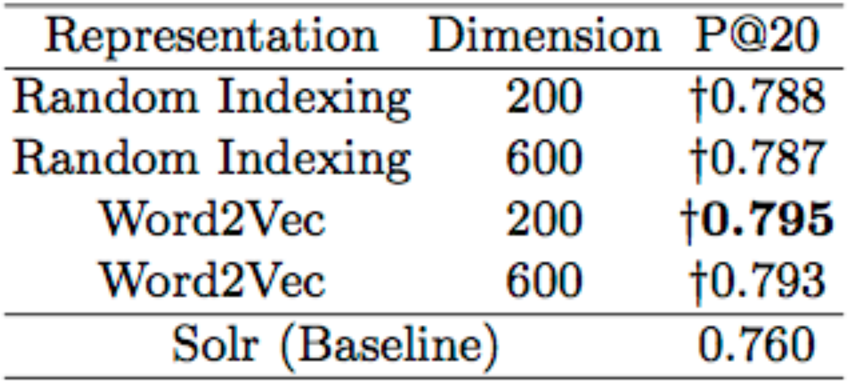

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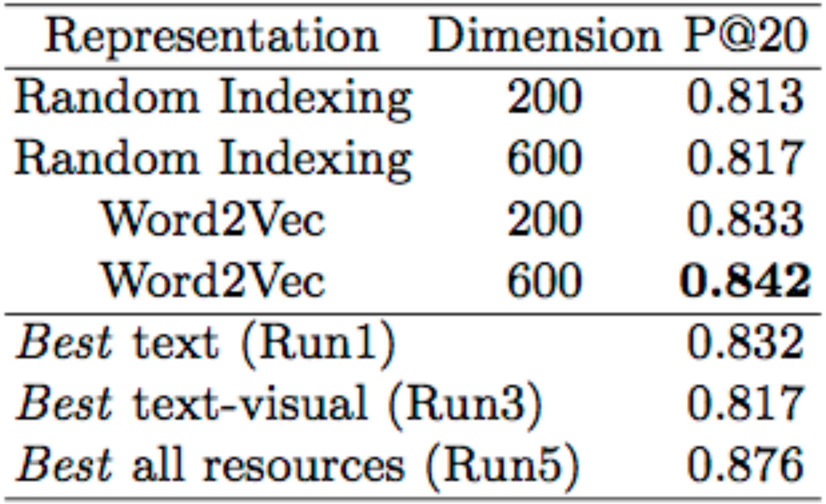
- Only on 2014



Representation	Dimension	P@20
Random Indexing	200	0.813
Random Indexing	600	0.817
Word2Vec	200	0.833
Word2Vec	600	**0.842**
Best text (Run1)		0.832
Best text-visual (Run3)		0.817
Best all resources (Run5)		0.876

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  - combines two retrieval methods
  - *n* percent of the first method is re-ranked by the second one

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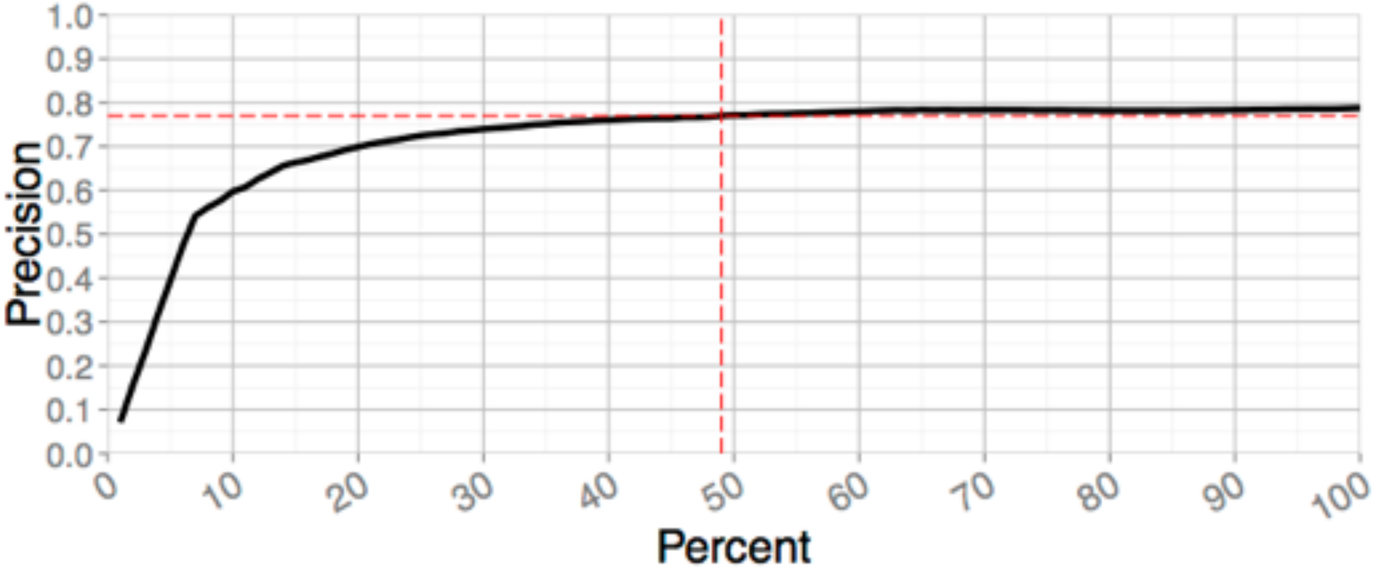
- Two-Phase Process
    - combines two retrieval methods
    - *n* percent of the first method is re-ranked by the second one
- Solr as the first, SimGreedy the second
    - checking all the possible values: *n*=49
    - with same performance, optimizes to almost two times



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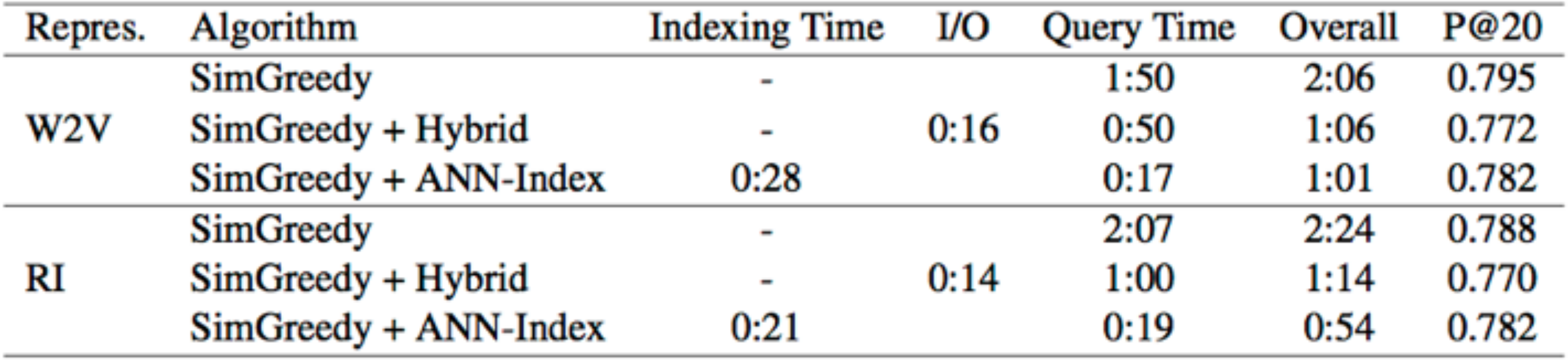
- Comparison
  - shorter *query time*, no parameter tuning



Repres.	Algorithm	Indexing Time	I/O	Query Time	Overall	P@20
W2V	SimGreedy	-	0:16	1:50	2:06	0.795
	SimGreedy + Hybrid	-		0:50	1:06	0.772
	SimGreedy + ANN-Index	0:28		0:17	1:01	0.782
RI	SimGreedy	-	0:14	2:07	2:24	0.788
	SimGreedy + Hybrid	-		1:00	1:14	0.770
	SimGreedy + ANN-Index	0:21		0:19	0:54	0.782

Conclusion

- Platform for Concept-based Multimodal Retrieval
- Social Image Retrieval
- Semantic-based Text Retrieval
  - Two term representations: Word2Vec, Random Indexing
  - SimGreedy method
  - Semantic Similarity method more effective than term-frequency methods
- Optimization: Hybrid & ANN-Index
  - both optimized time to half
  - ANN-Index more practical and easy to setup